approach

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TECHNOLOGY & SCIENCE

As the A-5A left the runway the

Emergency Abort

By LCDR J.B. McDaniel

"Abort the takeoff," as a phrase alone, means many things to many people. To the pilot at the controls it may be the direct result of a rapid evaluation and decision on his part . . . on its outcome may very well rest his future as an aviator, or life itself.

To the maintenance gang it may be simply a request through the maintenance boss to the pilot to check military power, a brake gripe or perhaps a previous propeller malfunction.

Increasing The Exposure Rate . . .

In certain circles of naval aviation, the operations officer is required to know the exact "GO" status of his ASW ready duty aircraft. This is sometimes done by utilizing a questionable practice—namely, an aircraft fueled to maximum capacity, fully manned by the ready crew, all systems functionally checked and then required to perform an aborted take off, stopping to the tune of heavy braking and max reverse, (runway conditions seldom considered). This maneuver is of dubious value and offers excellent potential for an AAR.

NATOPS and the various training squadrons do not cover this topic, nor is it condoned from an equipment reliability standpoint, because it does not guarantee that all systems will be in the "green" after the aircraft has been shutdown and then restarted.

At the Naval Air Test Center and other commands vested with research into the realm of controlled takeoff aborts, the objective of each run is clearly understood by all concerned, from the pilot down to the field facilities personnel. Whether testing a par-

The A-5A arced to the post as the tire blew. . .

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vay the port gear sheared as it struck a mound of earth...

The wing snapped up and over the fuselage . . . fire consumed the wreckage.

ticular airframe (or a change to it), a new type of field arresting gear, or barrier in all cases the problem at hand is given *much* premeditation and planning.

Be Prepared

Controlled test and evaluation of aborted takeoff methods and techniques are one thing, but how about the *Emergency* Abort? Are you always prepared for an abort situation as your bird roars down the duty, approaching liftoff speed—or are you preoccupied with the bird's performance via the gages, as well as staying on centerline, noting the IAS versus the amount of runway already traveled and how much of the duty is left, angle of attack just-in-case—all of these functions demand a considerable wedge of the pilot's concentrated attention.

Then suddenly you are aware of the illumination of one of a multitude of warning lights!!! More often than not, during the next few seconds the decision made will make the difference between flight and abort on-the-deck. Once the decision is made and action instituted, the pilot is definitely not out of the woods nor home safe yet! Many an aircraft has been struck and bent and the pilot killed or severely injured during this critical phase of operations.

Aborted takeoffs are not restricted to any one type of aircraft. On the contrary, the files are replete with numerous incidents and AARs involving every model of aircraft that the Navy operates.

All Aircraft Are Susceptible

As an opener for the heavy attack operators, let us consider an AAR that started out to be a routine maintenance taxi test and terminated in tragedy.

The A-5A had been downed for a port brake gripe. Maintenance had replaced the port heat stack (carriers, discs, pressure and backup plates) and the heat shield, in an attempt to rectify the discrepancy.

Operations was then contacted to furnish a test pilot for the required taxi test. The pilot was briefed on the bird's past brake history and told that the new brake assembly required a functional systems check to ensure that it would not bind due to normal frictional heating. The pilot then requested permission to fly the A-5 if the brakes checked O.K. on taxi. Due to the nature of the gripe which required Airframes

to remove and inspect the assembly after the test, the request was refused. The pilot acknowledged the no-fly status and asked if he should perform an aborted takeoff. He was informed that an abort was *not desired nor required*, and ONLY a brief taxi test was needed.

After a brief taxi check the pilot on his own initiative elected to conduct an aborted takeoff, *flaps up*. He taxied to the duty runway, requested and received clearance for the aborted takeoff, applied power and started his roll. After approximately 1800 ft of roll and 114 kts (estimated) the aircraft was observed to rotate to an excessively nose-high attitude and swerve to starboard. The port tire was observed to blow as a result of overcorrection for the swerve and the A-5 arced back to the port side of the runway. As the aircraft neared the edge of the runway, power was reduced momentarily, and the nose lowered. The A-5 then left the duty in a sharply increasing port swerve. Military power with AB was selected and the nose again appeared to over rotate. The port gear sheared as it struck a mound of earth. Continuing in a now violent swerve, the A-5 collided with stored inert ordnance, breaking the fuselage forward of the wing, spun around and slid backward into a drainage ditch. The wing snapped upward and the forward fuselage (cockpit area) came to rest under the drop tank of the starboard wing. Fire immediately enveloped the aircraft. The pilot received injuries which were eventually fatal.

Incomplete planning on the part of the pilot for a maneuver *not required* as a part of the intended taxi test, led to an induced abort situation that became unsalvageable.

The A-5 with flaps up provides only two degrees of throw in the vertical axis for the vertical stabilizer and, in this instance, coupled with an extreme aft CG as a result of fuel loading, over-rotation negated almost entirely the *use of nose wheel steering* for effective directional control.

The NATOPS Flight Manual does not set forth any requirement or procedures for the maneuver which was intended by the squadron, a taxi test, or for the maneuver intended by the pilot, a premeditated aborted takeoff.

The accident might have been prevented had the pilot lowered the nose, used nose wheel steering to regain directional control, retarded the throttles to idle and left them there and either braked to a stop or engaged the arresting gear.

He was highly qualified in type and a charger to boot. His professional ability and zeal failed to assist him when needed most. A new set of circumstances, encountered during the *induced* emergency pushed the situation beyond his capability to respond promptly and correctly.

It Can't Happen To Me . . .

Before you say "It can't happen to me," ask yourself this question. Have I ever pressed the situation at hand, tactical or otherwise, to the point where an emergency could have saturated my ability or the capability of my machine. The answer is yes, at least at some time in every aviator's career. You may have remarked after reading or being involved in a hairy one, "There but for the grace of God, go I." The author certainly has!

Supervisory responsibility cannot be overlooked as a factor in this accident. On the contrary, the overall analysis of this AAR reveals that supervision is essential even in the areas where it appears to be least required.

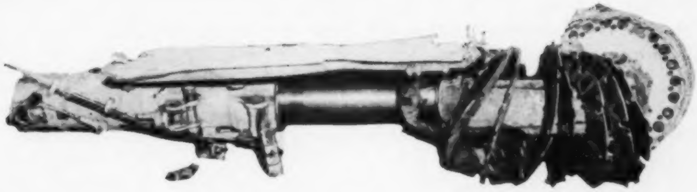
Prior to the accident, this pilot's good judgment and mature attitude gave little reason for command concern. However, because of his conscientiousness, confidence and what must now be analyzed as a casual attitude toward flight, the pilot shouldered the entire responsibility of performing an aborted takeoff when he was not prepared to contend with all the eventualities.

As was mentioned earlier the emergency abort is not confined to any one model of aircraft. Thus far considering only a two year time frame spanning FY's 65 and 66 to date, there have been 112 AAR's and incidents of this nature. The monetary consideration of these losses alone is staggering but coupled with the loss of life and subsequent lowering of our overall combat readiness, the Navy can ill afford the price.

Let's take another brief look, this time at what was to be a *routine* pre-acceptance test flight.

The weather was CAVU to the moon, with light winds right down the 12,000 ft duty, as the F-4B commenced the takeoff roll.

The pilot, highly experienced in model, accompanied by an RIO, settled down to the business at hand, monitoring the gages. Everything appeared normal in both cockpits as the F-4B gathered momentum. The aircraft was accelerating normally down the centerline of the runway, nose wheel steering engaged, half flaps, utilizing only military power. At 80 kts with all gages in the green, the pilot selected AB. Immediately following an apparently normal AB ignition, the F-4B started to veer left of centerline. Right nose wheel steering corrective action was initiated with little apparent response. The takeoff was immediately aborted, AB's deselected and the throttles retarded to the idle position.



The starboard strut sheared as it passed over the chain. Burning JP-5 trailing, enveloped the F-4B as it slid to a halt.

The starboard strut sheared as it passed over the chain. Burning JP-5 trailing, enveloped the F-4B as it slid to a halt.

The pilot and RIO were not out of the woods yet . . . at this time the nose wheel steering was disengaged by full right rudder and brake. A now violent swerve to the right commenced.

As the aircraft rapidly approached the starboard side of the runway, full left rudder and left brake were applied and the left MLG tire blew. The F-4B now began to swing back to the port but momentum and heavy side loading continued to carry the aircraft toward the right side of the duty, where the starboard MLG struck the arresting gear chain, which violently whipped the F-4B back to the right.

Shortly thereafter, the starboard strut and nose strut were ripped from the aircraft; the internal wing fuel cells ruptured and the port MLG collapsed.

The aircraft continued sliding trailing fuel for another 400 ft, finally coming to rest approximately 2800 ft down the runway on the dirt strip between the parallels.

The trailing line of ignited JP-5 now caught up with the immobilized F-4B and flames shot up 100-200 ft as fire engulfed the aircraft.

After the initial "flash" of fire both the pilot and RIO jettisoned their canopies, and hurriedly exited the immediate vicinity of the crash scene.

The crash crew arrived almost simultaneously as the pilot and RIO egressed and extinguished the blazing F-4B.

Why did it happen? How can an aircraft come unglued so easily and do so much damage in such a short distance and so few seconds? These are just a few of the typical questions that could be stated here concerning this proposed flight—

Monday morning quarter-backing will not provide all the answers but investigation did bring out some very interesting possibilities—

(1) The pilot overcontrolled for a swerve caused by an asymmetrical burner light-off.

(2) Inadvertent disengagement and re-engagement of nose wheel steering.

(3) Transitory inputs to the nose wheel steering system.

(*Ed Note—The bird had had a six month past history of nose wheel steering gripes.*)

(4) Stability augmentation yaw and roll system malfunctioned.

Board Conclusions

The accident board concluded that—

(1) In the absence of a DIR, the most probable cause factor was an erroneous transitory signal to the nose wheel steering.

(2) Correction for the initial left swerve, whether pilot induced or material malfunction, was excessively overcontrolled.

(3) Complete loss of directional control occurred when the starboard MLG struck the field arresting gear chain.

(4) The pilot did not violate NATOPS procedures.

(5) The relatively late jettisoning of the canopies undoubtedly saved the pilot and RIO from burn injury.

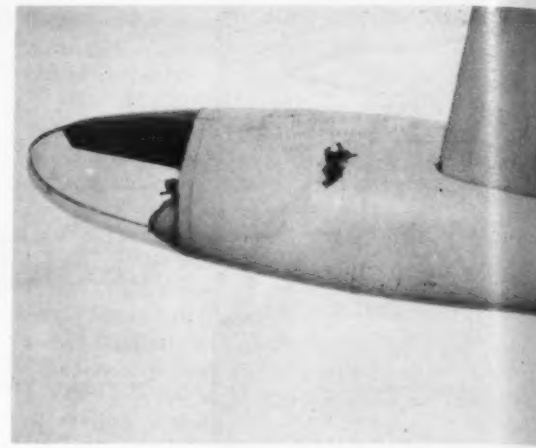
(6) The prompt response of the crash crew lessened the fire damage to the aircraft.

For those of you piston drivers that have made it this far without your interest waning completely, let it be said that prop abort situations can be just as critical and hairy as the two preceding cases.

Bear with the author for a bit more and quiz yourself as to how you would have handled this SP-2H emergency.

After approximately two hours of airwork, involving practice instrument approaches and simulated emergencies, the crew of the SP-2H returned to the traffic pattern for commencement of the landing phase of a PP2P check flight.

During the second full flap touch-and-go landing, and immediately after application of max power on the recips and 100 percent RPM on both jets, the radioman heard an explosion on the starboard side of the aircraft and observed heavy smoke and flames being emitted from an area outboard of the



starboard reciprocating engine. He immediately notified the pilot via the ICS, stating that he saw "fire in the starboard engine." The copilot also heard the explosion, and, moments later, noticed the starboard jet fire warning light ON. *Assuming that the pilot had seen the fire warning light, the copilot did not report the indication via the ICS.* Airspeed at this point was approximately 100-105 kts, with about 4000 ft of runway remaining.

The pilot, mistakenly assuming that the starboard reciprocating engine was aflame, immediately aborted the takeoff and commenced propeller reversing, followed by steady wheel braking as the airspeed dropped below 80 kts. He called for the copilot to secure the jets. The copilot, at this point, first moved both jet throttles to the OFF position, as called for in NATOPS abort procedures, and then repositioned the starboard throttle to STANDBY, IAW NATOPS emergency procedures for jet engine fires.

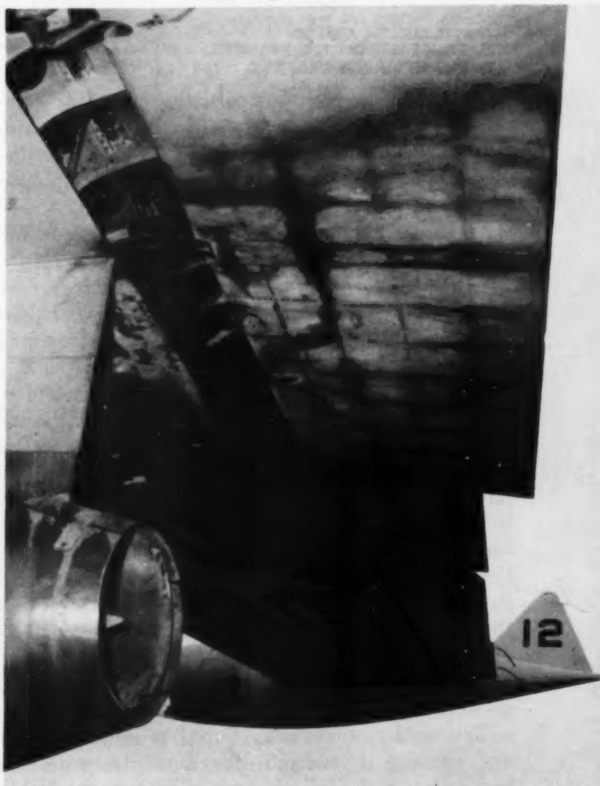
As the aircraft was braked to a stop approximately 600 ft from the end of the runway, the pilot was told by the tower that the aircraft's starboard jet was on fire. The pilot set 2000 rpm on the starboard recip to aid in keeping the flames away from the wing tanks. Simultaneously, the copilot initiated fuel starvation procedures in order to secure fuel flow to the starboard jet engine. During the copilot's haste to secure fuel to the burning jet engine, the port engine crossfeed valve was inadvertently left in the closed position, preventing fuel flow to the starboard reciprocating engine, which starved immediately.

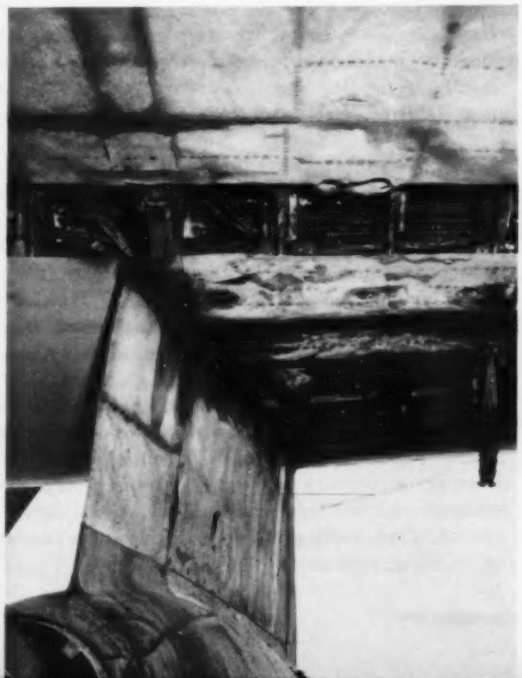
The radioman reported on the ICS that the starboard jet was still burning, and sent the second mech to the afterstation for a more accurate observation of the situation. Due to a faulty headset in the after-

station, the second mech added to the confusion by stating in the blind on the ICS, "We're on fire." He then went forward to the radio compartment to pass his observations to the pilot via the radioman's ICS facilities.

The Plane Commander, now having determined that the fire was beyond his control, requested, via UHF, that the tower dispatch firefighting equipment to the scene and ordered the crew to abandon the aircraft. The PPC then secured the reciprocating engines (the starboard recip had died earlier due to fuel starvation) by placing the mixture levers in the

When the compressor rotor disintegrated, super-heated metal tore into the fuselage and surrounding areas. Fire broke out in the J-34 pod area.





full aft position, turned the mag switches OFF, and exited the aircraft through the pilot's overhead hatch. The copilot secured the electrical system by hitting the crash bar, and exited through the nosewheel entrance hatch. The Plane Captain and bow observer departed the aircraft via the nosewheel hatch, and the radioman second mech egressed through the afterstation entrance hatch.

Crash/Rescue personnel arrived on the scene as the crew abandoned the aircraft, and extinguished the fire in the starboard jet engine area.

The primary cause of this flight incident, unknown to the crew at the time, was the disintegration of the second stage compressor rotor of the starboard jet engine, which led to complete failure of the engine and started the ensuing fire.

Jet engine operation throughout the previous portion of the flight had been normal, with exception of slightly hotter-than-usual starts (820°C), both in the air and on the ground. At the time of the rotor failure, engine RPM was between 99 and 100 percent, as stated by the copilot.

The fire in the engine area, ignited at the time of rotor disintegration, was fed by fuel from the main inlet line, which was partially sheared by compressor fragments. After the fire had been extinguished, fuel continued to flow from the severed line due to the jet fuel shut-off valve remaining open (starboard jet throttle in STANDBY).

Two contributing factors were considered to be relevant to the extent of fire damage to the aircraft.

(1) *Pilot deviation from NATOPS procedures*—Subsequent investigation revealed that two deviations from NATOPS emergency procedures were involved during the mishap.

After the pilot aborted the second touch-and-go landing, the copilot placed the starboard jet throttle in the STANDBY position vice in OFF, as called for in the NATOPS abort procedure section. With the jet throttle in STANDBY, the jet fuel shut-off valve, in the beavertail area, remains open and will allow fuel flow to the jet engine as long as the supply from the tank lasts. This error, in itself, would not have been serious or contributory to feeding the fire if the jet fuel starvation procedure had remained in effect. However, when coupled with the pilot's error, as previously explained, the combined effects allowed a continuing flow of fuel to feed the blaze.

The copilot, after being forced to secure engines and abandon the aircraft, placed both mixture control levers in the full aft position vice in the IDLE-CUTOFF position. This action initiated feathering of the propellers, shut off oil and hydraulic fluid to the engine, but most important, it rotated the port and starboard crossfeed valves to the FUEL OFF position. In the FUEL OFF detent, the crossfeed valves isolate the engines from a fuel supply; however, this action opens the plumbing to crossfeed between port and starboard fuel tank systems and allows fuel to reach the jet engines. Since the starboard jet shut-off valve was open, the pilot's action in bringing the mixtures full aft opened all valves necessary for a direct flow of fuel to the burning jet. Although the boost pumps were not operating (electrical power secured by crash bar), *gravity flow from the main tanks was sufficient to provide a steady stream of fuel.*

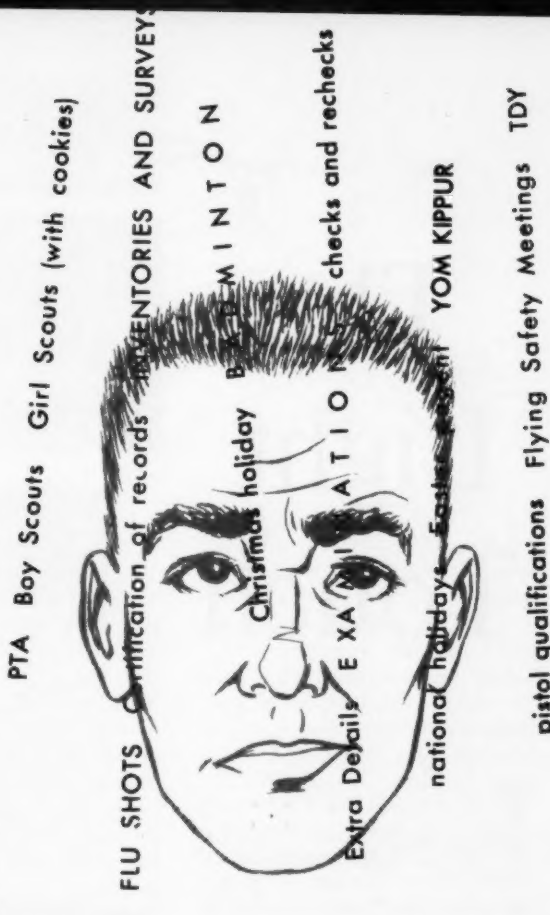
(2) *Incorrect operation of aircraft systems*—As the aircraft came to a stop after aborting the touch-and-go landing, the copilot initiated fuel starvation procedures in order to prevent fuel flow to the starboard jet engine. This procedure calls for (1) opening the port engine crossfeed valve; (2) opening the starboard engine crossfeed valve; and, (3) turning the starboard fuel tank selector valve to the OFF position. This operation is in accordance with NATOPS and Flight Handbook emergency procedures for jet fires, both in flight and on the ground. During the copilot's haste to secure fuel to the burning jet engine, he inadvertently left the port engine cross-feed valve in the CLOSED position, preventing fuel flow to the starboard reciprocating engine which starved immediately and quit. The starboard recip engine, at the time of inadvertent secure, was turning at 2000 rpm to aid in blowing the flames away from the wing and engine areas. As the engine died, the lack of slipstream allowed the flames to contact the lower and aft wing surfaces, possibly causing more severe damage to the flap and lower wing skin than would have occurred if the engine had remained in operation.

Command Attention Required

Command must continue to impress upon the potential "tiger" that to be one is not enough in itself. Tiger blood must and can be tempered with liberal doses of common sense. His (the tiger's) performance must be monitored to ensure that maturity is developed commensurate with the pilot's aeronautical ability to the highest professional level.

These accidents substantiate the fact that, even where the best qualified personnel are concerned, and where routine missions are to be performed, exacting supervision is *required*. Only by continued intensive training concerning normal and emergency procedures, and through constant mature supervision can accidents such as these be reduced in number, or entirely eliminated.

The Horrendous Hazard of 'Fall In'



With the bigger and better bombs we have now days, "Fall Out" seems to be the big worry. After checking up on the figures and statistics though, I find few if any, pilots die of fall out. Most are the victims of "Fall In." This "Fall In" is the gradual fading of proficiency in driving the ole bird around. When I try to pin down who's at fault, I find a most serious dilemma.

Everybody is at fault. Trouble is the penalty is paid in full by one man alone—the pilot.

The pilot is sucked into this "Fall In" problem by very small steps. He has a desk job and a few extra duties, such as bonds officer, burial details officer, duty officer, welfare-recreation officer, morale officer and all kinds of meetings. He is expected to meet the public, learn a foreign language and ramrod various fund campaigns. There are flu shots, physicals, exams, checks and rechecks, certification of records, inventories and surveys, pistol requalification, moral dynamics, Flying Safety Meetings and reading a book a month. On the weekend, there are outings, golf, bowling, pistol shooting, badminton, monopoly and tiddly-winks. In the evenings he is involved in receptions, TDY, classes, PTA, Boy Scouts, Girl Scouts (with cookies) and religious activities. Two for one and support the club night crops up. There is Christmas and Yom Kippur, Easter pageants and national holidays. We are strongly urged to take 30 days' leave. What about guest speaking engagements? Each year we have inspections to pass, requiring attention to . . . haircuts, shoe shines and uniforms. Carrying sick kids to the hospital is an occasional necessity. I heard one pilot say he sure would like to go to the men's room but he forgot to put it on this week's schedule. That's how it goes!!!

There is only one little fly in the ointment. Statistics show that your chances of being killed are greater by flying than any one of the above activities. And how many people are you going to take with you? It is indeed hard to blame any individual activity for taking up your time. Studying the handbook and NATOPs doesn't even appear on your ODCR, but if the misfortune of a flying mishap comes your way, the quick and correct action can do more to keep you alive than the whole kit and kaboodle I've outlined above. That flight pay you receive becomes more like hazard pay the further you drift away.

I'll give you odds some people around sort of consider studying the Flight Handbook and reading the Ladies Home Journal in the same class (They hate like sin getting caught reading it during duty hours, you know). Well, it's time we stood back and took a good look at what's important and what comes first. You have 100 hours a year to fly and you set your own time to study and take Link. How's about defying gravity and not falling in?

Let's hope I see you in the prevention phase of safety instead of during the investigation phase.

—Adapted from USAF Safety Tips.

The Light Touch

Some wheel tracks and a scorched path—

and in the grass a broken runway edge light

verifies a very close call.

8

This close call had a typical beginning: it was a dark night in the FMLP pattern. Everything was normal on the first pass on the mirror *except* that "paddles" called me for flashing lights. After bouncing and starting to climb, I reduced power to about 90% to prevent getting fast and turning too wide abeam.

I then committed a cardinal sin. Passing through 200 feet and climbing I thought to myself "I'll check those light switches quickly because I know I set them correctly when downwind the first time." The "quick" look into the cockpit allowed enough time for

The purpose of an Anymouse (anonymous) Report is to help detect or prevent a potentially dangerous situation. They are submitted by Naval and Marine Corps aviation personnel who have had hazardous or unsafe aviation experiences. As the name indicates these reports need not be signed. Self-mailing Anymouse forms are available in readyrooms and line shacks or through your ASO. All reports are reviewed for appropriate action.

— REPORT AN INCIDENT, PREVENT AN ACCIDENT —

the aircraft to descend back through the 200 ft I had climbed. When I looked back out of the cockpit, there was a red light coming past my starboard wing. Instinctively I shoved the power to 100% and rotated to the buffet.

I do not remember feeling any touchdown or roll. I thought I had caught it just in time, and I considered it as only a *very* lucky lesson. I then turned downwind, settled down as much as possible, and continued the period.

As it turns out, I did catch the descent in time to prevent a fatality, but the wheels did roll across grass and sandy soil for about 100 ft. If I had waited any longer, weight would have been on the wheels, and the gear would probably have sheared.

The lesson learned, *well learned*, was to get established first, and then check the cockpit. This is particularly true when close to the ground. For this once my mistake was forgiven but the wheel tracks and scorch marks in the grass will remain as a *vivid* remembrance.

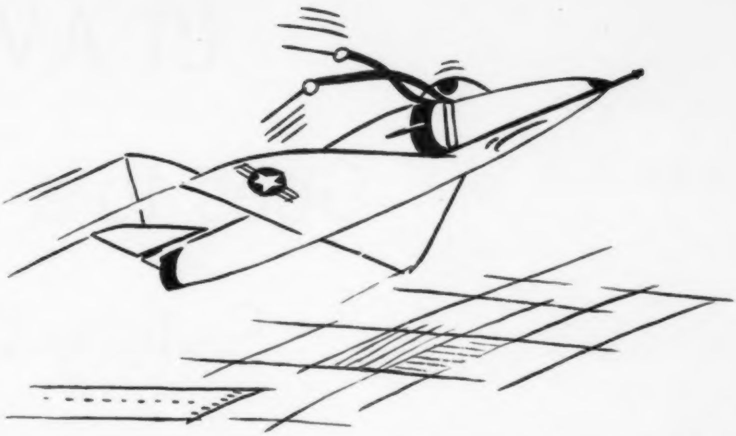
A last note of irony, the wing light and tail lights were steady, but I had gotten the wrong switch for the rotating beacons which were still on.

Seat Pin Problems

Anymouse was scheduled for a night plug-in hop in an A-4. After completing his ground inspection he climbed up to the cockpit, preflighted the seat and removed the two top seat pins before entering the cockpit.

At the time it was his habit to leave the canopy jettison pin in place until he was situated in the seat. This time, however, he forgot and closed the canopy with the canopy jettison pin still in place and the other two pins hanging outside against the fuselage.

On takeoff the pilot heard a rattling sound. Still not realizing it was caused by the pins, he surmised that noise might have been coming from the air conditioning system and decided to abort the hop.



After dumping fuel, he transferred the drops and when down to landing weight made an uneventful landing. The engine ran beautifully throughout the brief hop.

While inspecting his aircraft after shutdown the pilot discovered that the pins were missing and requested a visual inspection of the engine. Sure enough, the pins had been ingested and an engine change was necessary.

This pilot now pulls all three pins, rolls them up and places them in the pin holder before entering the cockpit. *This procedure is in accordance with all A-4 NATOPS manuals. However, caution should be taken to avoid hitting the canopy ejection handle with your foot when entering the cockpit. . . Ed.*

Who's Who & You!

If you have a book or file entitled "Who's Who In Naval Aviation," how 'bout taking a pen and ink change under "A" and add the following facts:

A-Anymouse, (n), rate/rank, variable to suit the occasion; laundry number unknown.

Contrary to popular opinion, Anymouse does NOT reside at the Naval Aviation Safety Center—Anymouse is YOU! Anytime you have an experience or a safety idea which you feel is worth writing about, YOU are Anymouse if you relate your experience on an Anymouse Report Form—or even if you do it in an ordinary anonymous letter.

Let it be understood that the tales need not necessarily be hairy, and they certainly are not limited to pilots or aircrewmen only. Anymouse is any person who reports something that he has done, seen, or experienced, that he's man (mouse) enough to admit in writing so that others in aviation may benefit, but that he may wish to keep anonymous for obvious reasons.

While NASC is interested in hearing of unsafe practices, the system is not a tattle-tale vehicle for reporting conditions within a command which should properly be reported through command channels.

New Anymouse forms are at your squadron, now—let's have that one you've been intending to send in.

LT A.V. Safeoff

Goes to a

Safety Conference

By C

ce

By CDR D.M. Layton, Staff, PG School, Monterey

THREE MONTHS AGO I COULDN'T EVEN SPEEL INGINEAR, AND NOW I ARE ONE. Lt Arthur V. Safeoff had never really appreciated that sign over the designer's desk at the aircraft company until just recently.

But now, less than a month after the exec had first spoken about the safety billet, and on the day of Art's return from the 5-Day Safety School*, Art discovered that "he are one." The previous safety officer had been detached during Art's absence and now the job was his—all his.

Jack had been a very meticulous person and his files were a thing of beauty. "No problem here," Art thought to himself, "at least everything is well organized, filed and indexed." But it was these very files that gave Art his first indication that all was not as it should be in the squadron safety effort.

The first thing that he noticed was a complete file of *"Crossfeeds"* neatly bound in folders for the various subjects—Pilot, Maintenance, Escape and Survival, Ordnance, Facilities, and so forth. Art recalled the words of one of the members of the Safety Center staff, " *'Crossfeeds'* are a means of direct correspondence on vital interest items. They are originated and signed by the Analyst who has cognizance over that aircraft or piece of equipment. But they are *not* private correspondence." Art agreed wholeheartedly with the concept of this publication series—unless the officer/technician who needs to know about this material has *ready* access to the *Crossfeed,* the time and effort expended in the writing and distribution has been nearly a total waste.

As Art separated the various sections, he decided he would personally deliver the Maintenance portions.

*LT A. V. Safeoff Goes to a 5-Day Safety School—APPROACH February 1966, p. 6.

This would give him an excuse for dropping into the shops to talk to the men about their safety ideas. The first step proved to be a winner. AMS2 Martin, who was just completing some work, had the very type of comment which Art had hoped he might dig out over a period of several weeks.

"You know, Mr. Safeoff," Martin said, "we have the potential for an accident on this bird every time we fly. Although the gear drops by gravity—it must be unlocked by hydraulic pressure. A busted line or fouled up valve, and all the gravity in the world won't get that gear down." "That's a pretty rare occurrence isn't it?" "Well, I know of a couple of times that it has happened. All that you need is a mechanical override and there would never be any problem. But I guess that is too simple for the experts, so someday we'll have to belly one in."

Art made some detailed notes in the small notebook that he was carrying and over a period of several weeks he found he had picked up quite a few ideas for both hardware and technique improvement. He was glad that he had done this "homework" when the Admin Officer routed him a letter from the Naval Aviation Safety Center stating that a safety conference was to be held at the contractor's plant the following month.

All activities that flew the recent production aircraft of this manufacturer were to submit proposed agenda items and to furnish a representative if they could. Art roughed up a reply and took it to the Exec so he could discuss the items that he had suggested. Thanks to his little notebook, Art had covered all of the items that both the skipper and the exec had thought of, and at the commanding officer's suggestion, Art then presented his list at an All Officers Meeting to get the opinions of the others in the squadron. He also made certain that all of the maintenance chiefs got a look at the list *before* it was submitted.

A couple of weeks after the deadline for submission, the squadron received a schedule for the conference. Art had been assigned to one of two committees that covered their model. Two of his items had not been accepted since they were NATOPS subjects and this conference was to concern itself with hardware items. Another of the squadron's items was to be discussed by the other committee, since it was an electronic problem and all of these had been collected under one committee. Brief background material was furnished for each item, along with the basic rules for the conference.

Each committee would discuss their assigned items, determine if it were truly a safety matter, and if so, make a recommendation, when possible, for the resolution of the problem. The policy committee would then review each subject and make a final ruling on what action was to be taken and what activity was to initiate the action. Then all of the items from all committees were to be discussed in open session to afford an opportunity for rebuttal if necessary.

Art got a ride to the conference on the airlift that Fleet Air had arranged. The first morning, after registration, the meeting was opened with introductory remarks from the senior Safety Center representative and from the president of the company. The class analysts from the safety center then presented a summary of recent accident, incident and ground accident occurrences and the company gave presentations on some of their safety work and on new models and modifications that were underway or still in the drawing board stage.

After lunch, final committee assignments were

made and everyone got down to serious work. Art noticed that his committee, which was composed of both fleet and staff pilots, had several official representatives of the manufacturer as well as quite a few onlookers in the rear rows. The chairman, who was the senior naval aviator on the committee, had gone over the items after a briefing from the Safety Center and had prepared a proposed order of consideration—the easiest or simplest matters were to be disposed of early, leaving ample time to take up complex and related matters together.

One of the first items had a proposed solution in the contractor's handout that seemed satisfactory to Art. He wasn't aware of this problem since it occurred only on a special version series of the model. The people who submitted the item, however, didn't like the contractor's proposal. "That's a good idea," one of them said, "but it doesn't solve the real problem." After he had elaborated on the difficulty they had encountered, one of the company members sent out for the engineer who had cognizance over that equipment.

The engineer was surprised to learn the exact nature of the problem. "From the information we had received, we thought it was the switch that needed to be changed. I can see now that it is the guard arrangement which should have been modified. We'll look it over and see if we can come up with something before the conference is over." Art was doodling on a piece of paper and noticed that he had written the word "*Communication.*" How true. The company had found a fix to the wrong problem because there was a lack of complete understanding between the operator and the manufacturer as to what was really wrong.

The next item was one of Art's. It was a simple thing and had a simple solution. If the UHF control box was moved over to the left side the pilot could reach it without letting go of everything. It wouldn't cost anything—the cables were long enough to reach. One of the staff members stated that he had talked to the Air Systems Command project officer about this and he stated that the reason the control couldn't be shifted, and why it wasn't located on the left originally, was that this space was reserved for a new tactical control that had been a long time in development, but was soon to reach the fleet.

There was unanimous acceptance of Art's idea (or should we say AMS2 Martin's idea?) about the mechanical unlock provision for the landing gear. The company estimated that it would cost about $250,000 to engineer a mechanical override system and to provide service change kits. No argument here, but there were arguments on many of the other matters.

Is it safety or is it not? Is it needed or is it not? Should it be changed, or left as it is? Should we say "shall" or should we use "will?" Discussion, poring over blueprints and through handbooks, black coffee, suggestions and counter-suggestions took up all of the first afternoon, the entire second day and part of the third morning. Finally, however, *all items were finished and* it was announced that they were ready to go back into complete session to hear the final reports.

The Policy Committee, which was composed of the senior representatives from the Safety Center, Fleet staffs, OpNav and the Air Systems Command, had approved almost all of the recommendations forwarded from the committees and for each item approved had designated who was to submit the data or originate a request for a change. At first Art was dumbfounded when the policy committee announced that they had rejected the override for the landing gear. No one in the committee had objected. The company said it was feasible and not too difficult. What then was their reason? He didn't have to ask because they gave an explanation with each decision. On this item the manufacturer estimated $250,000 to devise a fix and provide the necessary parts.

The records of the Naval Aviation Safety Center, however, indicated that in over 600,000 total flight hours, this gear up condition had only happened five times. All were due to maintenance error, all had resulted in minor incidents, and the total cost of repairs for all five was less than $10,000. None of the aircraft had been out of service longer than the time required for a minor periodic check. Why then spend $250,000 to protect one? "Why indeed," Art thought. "We could use that quarter of a million dollars on some of the other items of greater hazard potential."

In the closing remarks for the conference, the Safety Center spokesman stated that the meeting was not really closing. A final report would be mailed to all of the activities that flew these aircraft, whether they were able to attend or not, and all of those who did have the opportunity to attend could continue the meeting back in the squadrons by discussion of all of the items.

And perhaps even more important to the theme of a continuation of the conference, everyone was reminded that Aviation Safety is not a once-a-year conference at the manufacturer's plant, nor a weekly pilot meeting in the readyroom. Aviation Safety is a day by day, hour by hour, minute by minute business for all hands. And you can bet your life on that!

INFLIGHT FIRE

The helmet and mask you see in the accompanying photograph belong to a pilot with 1384 hours, primarily in A-1 model aircraft. During his third solo flight in the T-2B, he lit a match, precipitating a fiercely torching oxygen mask fire. The fire was so severe that it melted the right earpiece of his helmet, fusing the mask cheek flap and retention straps to it, and melted the right side of the visor. Second and third degree burns of his face and hands will require plastic surgery.

After takeoff the pilot climbed to 20,000 ft and conducted familiarization maneuvers for about 50 minutes. He then descended to 6000 ft to operate at low altitude before entering the traffic pattern. While at 6000 ft, he removed his left glove, disconnected the left side of his oxygen mask and, as he explained it later, "lit a match to get rid of some raveled ends on my torso harness chest strap."

The oxygen mask generated a sudden burst of flame. Instinctively, the pilot shut his eyes and held his breath. Holding the torching mask away from his face with his ungloved left hand, he struggled to pull his helmet off with his right hand. He did not try to release the right mask fitting. After managing to remove his helmet, he turned the oxygen off at the console.

In spite of his severe burns, he had no difficulty controlling the aircraft. He saw that he was burned but was not aware of any pain until the aircraft was in the chocks. Failure of the dynamic microphone under the intense heat secondary to fusion of internal elements necessitated a "no radio" signal to the tower. He entered the traffic pattern, made a normal landing and taxied into the line.

This pilot's flight clothing protected him from more extensive burns. Although his torso harness and flight suit were burned through in two spots over his chest, his thermal underwear and T-shirt were only scorched.

Habit pattern interference with normal safe function is vividly illustrated here, the investigating flight surgeon stated in his report. "The lighting of matches incident to smoking is not uncommon in the model of aircraft in which this pilot had flown the majority of his total hours of flight time," the flight surgeon noted. "This is generally unacceptable in the model aircraft involved in this mishap. The transfer of habit patterns from one model aircraft to another is a well-recognized but insidious, potentially dangerous mechanism and must be particularly rigidly monitored in familiarization state flights." The pilot is a heavy smoker and carried cigarettes and three packs of matches in his flight suit.

"(This pilot's) recent physiological training, awareness of his lack of experience with oxygen systems, and his status as a transition pilot to a new model of aircraft (jet) should have alerted him to be particularly critical of even his routine procedures.

the flight surgeon said.

The pilot reported, "I realized my mistake at the same time as the mask burst into flame."

The flight surgeon's recommendations on the mishap were:

- The dangers in habit pattern transfer during transition to new aircraft and/or systems should be specifically and strongly emphasized as a formal part of all checkout procedures at squadron and unit levels as well as within training commands.
- Serious consideration should be given to the possibility of including actual demonstrations of oxygen mask fires as a part of physiological training unit syllabi. The demonstration would be vivid and impressive far beyond the verbal cautions now offered. Using surveyed masks, it could be safely and practically conducted.
- There should be further reemphasis on the incongruous balance of values between smoking and/or thoughtless use of matches in oxygen-equipped aircraft and the possible resultant severe injuries and aircraft damage.

(Generally speaking, when airborne the cockpit is a poor place to attempt a torso harness repair. Remember, oxygen systems and open flame can spell disaster.—Ed.)

NATOPS on Smoking in Aircraft

"*Specific Restrictions*: Smoking in naval aircraft is FORBIDDEN under the following conditions:

1. During fueling operations including transfer and defueling.
2. During and immediately after takeoff.
3. Immediately before and during landing.
4. Whenever any gas fumes are detected in the aircraft.
5. During all ground operations.
6. In the bomb bay or the fuselage or hull compartments which contain gasoline tanks.
7. In aircraft where fuselage or hull tanks are installed, smoking shall not be permitted in compartments adjacent to the fuel tank compartments except when all doors and ports of such compartments are secured.
8. In the cabin when cargo of a flammable or explosive nature is aboard.
9. During inspection of plane compartments wherein gas fumes may have collected.
10. Whenever oxygen equipment is in use.

"*Seaplane Model Aircraft*: Commanding Officers of seaplane squadrons may designate specific compartments within seaplane model aircraft in which smoking may be permitted during prolonged mooring periods, provided it has been determined a safe compartment exists and adequate safety precautions are published.

"*Command Directive*: Subject to the foregoing provisions, commanding officers of organizations or activities to which naval aircraft are assigned shall issue directives as necessary to govern smoking in aircraft.

"*Passenger Aircraft*: For aircraft regularly employed in transporting passengers, appropriate orders and regulations shall be promulgated by the responsible commands with due regard for the fire hazards involved in the model or aircraft in use. These orders and regulations shall be prominently displayed. Compliance thereto shall be the responsibility of the pilot in command of the aircraft, who is empowered to prohibit smoking at any time or in any part of the aircraft when he deems such action necessary for safety."

—Section 730, OpNavInst 3710.7C
1 November 1965

Jet Engine Fuel Control

By LCDR W.T. Brooks

Annually naval aviators review their knowledge of instrument flight and airways procedures and are examined on them both by written examination and in actual flight. A NATOPS procedures exam and flight check is required annually in most operational and training squadrons. In both review and examination most aviators learn something new every time.

All jet pilots at one time or another have read or been "exposed to" at least some theory of jet engine operation. Most have forgotten a great deal of it, and some never knew much in the first place.

The following discussion of the jet engine fuel control may help jet pilots better to perform their missions with success and to handle emergencies when they arise. It is not intended to supersede or replace the treatment of the subject in NATOPS/flight manuals, but to augment them with fundamentals.

The Jet Engine Fuel Control

One basic difference between a jet engine and a reciprocating engine is in the method of controlling power output. In the reciprocating engine, power output is modulated by controlling the amount of air intake to the engine. The jet engine power output is modulated by controlling the amount of fuel supplied to the engine. However, in NORMAL fuel control the throttle does not directly control the fuel flow to the engine. To better understand the functions of a fuel control and what happens when the throttle is moved it is necessary to look at the basic fuel requirements of a jet engine.

Figure 1 is a graph of fuel requirements of a jet engine plotted against the engine speed. The fuel flow requirements are plotted for a low altitude and a high altitude. These lines give the amount of fuel required to maintain a constant RPM (and a constant thrust) under one set of conditions (i.e., altitude, pressure, temperature, airspeed, etc.). The more air passing through the engine the more the fuel flow required to the engine to maintain a given RPM.

In normal fuel control the throttle *selects an RPM*. It does not determine the fuel flow. The fuel flow is modulated by a centrifugal governor that adjusts fuel flow to maintain the selected engine RPM. Under constant RPM and steady state conditions the flyball governor is the only part of the fuel control that is doing any work.

Figure 2 illustrates why the expensive components of a fuel control are required. The solid line again represents the fuel flow required to run at a given RPM for one set of conditions. Any fuel flow greater than this amount will cause the engine to accelerate and any fuel flow less than this amount will cause the engine to decelerate. The crosshatched areas on the chart are "prohibited" combinations of fuel flow and RPM for these conditions. Operating in the upper region will cause the engine to stall or chug. The reason for this is that the high combustion temperatures caused by the excessive amount of fuel raises the pressures in the aft sections of the engine. This increase in *pressure* raises the pressure ratio across the compressor resulting in a lowering of air velocity within the compressor.

For an axial flow engine lower air velocities mean higher angle of attack for each blade. The blade will stall if the angle of attack becomes too high in the same way that the wing on an aircraft will stall. This causes a further reduction in air velocity through the engine (equivalent to loss of lift of a wing) and

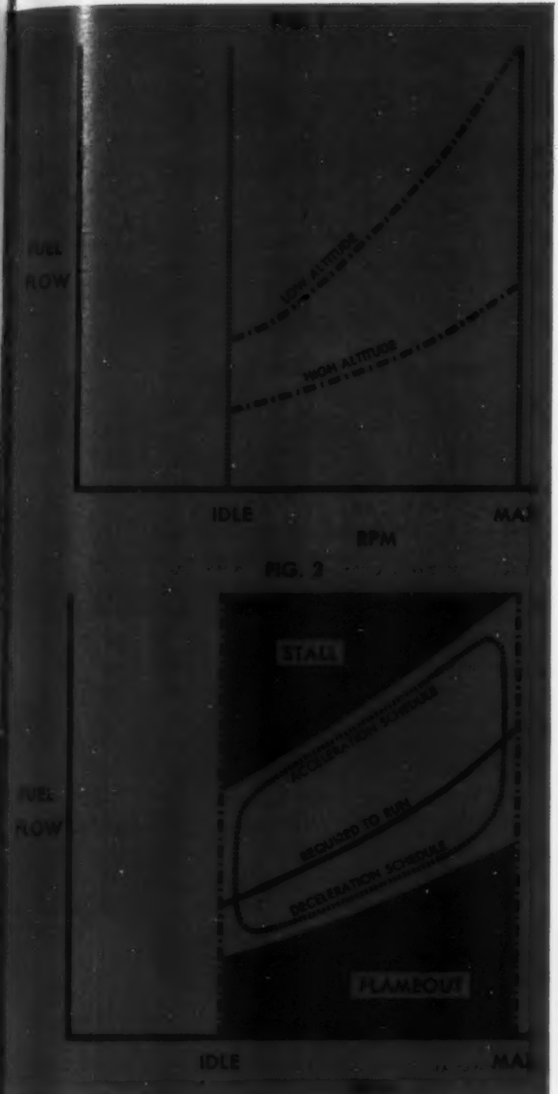


FIG. 2

a reduction of RPM (increase in drag). A centrifugal compressor, while not as sensitive to this effect, will also stall with similar results. A turbine engine operating in a stalled condition is literally "spinning in." If operated for very long in this condition it will destroy itself due to high temperature failure of the turbine blades.

Fuel flow/RPM combinations in the lower prohibited region will result in a flameout due to low fuel air ratios in the primary combustion areas of the engine burner section. The fuel control operating in its normal mode prevents fuel flow/RPM combinations that are in these prohibited regions. It does this by limiting the amount of change of fuel delivered to the engine when an RPM change is called for by throttle movement. These limits are the acceleration and deceleration schedule and are marked in dotted lines in fig. 2. Controlling fuel flow to these schedules is the most critical function of the fuel control. The acceleration schedule must be as far enough above the "required to run" fuel flow as possible to permit rapid acceleration of the engine. However, it must not exceed the FF/RPM combinations that would cause the compressor to stall.

During deceleration, too rich a deceleration schedule will make the engine slow to respond to a reduction in throttle and too lean a schedule will result in a flameout. As these prohibited regions vary with every combination of altitude, pressure, temperature, airspeed, aircraft attitude, etc., the fuel control has to be a complex and critical mechanism. As with all complex equipment in general it can go wrong.

Manual fuel controls are provided for just such occasions. A manual fuel control is one of the simplest and most reliable devices in a jet aircraft. It is merely a valve used to directly control fuel flow to the engine. It operates like a water faucet. In fact a water faucet could be used as a workable manual fuel control. The jet engine itself doesn't know if fuel is being delivered by the manual or the normal fuel control or by buckets. It will operate the same in each case. However, when the engine is being operated on the manual control the pilot must insure that the engine neither

To bring an engine out of a stall it is necessary to reduce the compressor pressure ratio.

stalls nor experiences a flameout. This can best be accomplished by slow and smooth movement of the throttle.

Some engines have manual fuel controls that are slightly more complex than the "water faucet" type. These have an aneroid device that decreases fuel flow with increasing altitude for a given throttle position. This allows the throttle position to be approximately the same for a given RPM at all altitudes. If the manual fuel control does not have an aneroid device, then it can be seen from Fig. 1 that the power control must be retarded to maintain a given RPM as altitude is increased.

Consideration of the power control as an "RPM SELECTOR" when the engine is operating with the normal fuel control is helpful in inflight troubleshooting. As stated earlier the engine requires one fuel flow to operate at a given RPM for one set of external conditions. If at a set altitude and airspeed, the RPM remains constant as selected and both the EGT temperatures and fuel flow increase, then you probably have trouble, but *not* with the fuel control. The trouble is probably with the engine itself. Loss or damage to *one or more* compressors or turbine blades or a bearing failure may have occurred. In any event there will probably soon be other indications of the difficulty. If only one of the three parameters, fuel flow *or* RPM *or* EGT, change and the other two remain constant then the trouble is neither a fuel control nor an engine malfunction but *is* an instrument failure.

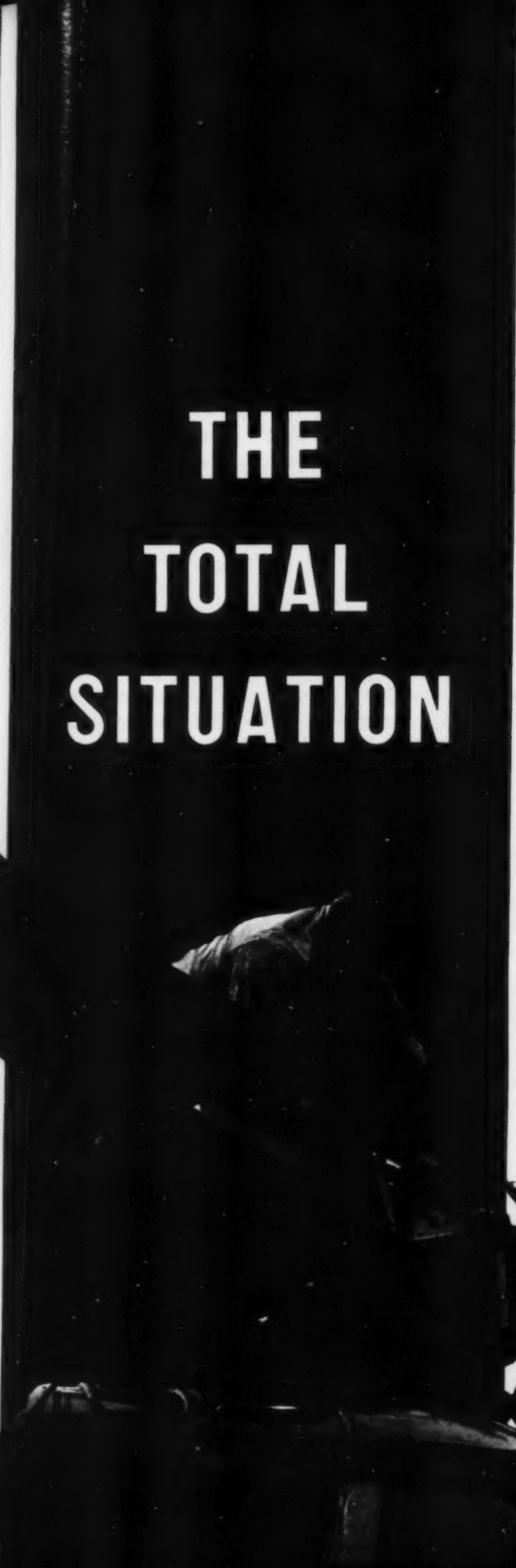
If all three of the above parameters are changing spontaneously together then there has probably been a *fuel control* malfunction.

Fuel flow, RPM and EGT will rise or fall roughly together. The trouble can progress to a point where the engine flames out, the engine stalls or the operating limits of the engine are exceeded. If this type of malfunction occurs on a multiple engine installation without a manual fuel control there are only two courses of action to take—live with the malfunction if it is not too bad or secure the engine. If a manual fuel control is available, switch into manual using the handbook procedures for your aircraft.

A compressor stall can be encountered in either manual or emergency fuel control. Compressor stalls are caused by too high a pressure ratio across the compressor for the existing conditions. This can come about by several means. Very high angles of attack or yaw will cause separation of air in the duct and lower or distort the pressure at the face of the compressor. A malfunctioning variable ramp intake duct on some of the new supersonic aircraft will also have a similar effect. When ingested, rocket exhaust or gun gas can raise the inlet temperature and cause the engine to stall. Any flow restriction downstream of the compressor will raise the pressure at the rear face of the compressor and can contribute to a stall. This flow restriction can be mechanical, i.e. stuck afterburner nozzle, or thermal such as excessive fuel flow on attempted acceleration. To bring an engine out of a stall it is necessary to reduce the compressor pressure ratio. This can be done by increasing the pressure at the face of the compressor which in turn can be accomplished by increasing indicated airspeed/reducing angle of attack/yaw. The power control must be reduced to idle to reduce flow restrictions down stream of the compressor. At very high altitudes the fuel flow at idle may be great enough to keep the engine stalled. If this occurs then the engine *must* be shut down to prevent the turbine from being damaged by over-limit temperatures.

Some of the factors that may make one engine more prone to stall than another similar engine is minor damage to the compressor, a dirty compressor, misrigged inlet guidevanes or at very high altitudes the normal variations in the acceleration schedules between different fuel controls. However, in all cases the corrective action is the same and must be applied immediately to prevent damaging the turbines.

THE TOTAL SITUATION



A significant trend in the assessment of accidents has been recognition that, although the actions of an individual pilot may lead to an accident, it does not necessarily follow that the fault therefore lies solely or even mainly with that pilot. Rather, when the actions are a reasonable result of the circumstances and the available information, the blame and preventive action must encompass the total situation, not just the last link in the chain.

Accidents attributed to "Maintenance" require a similar approach. Many of you will have had the profoundly disturbing experience of being confronted with the results of an investigation in which a tradesman with an outstanding reputation for skill and integrity has contributed to an accident. In these circumstances it is not enough to determine which maintenance job was left undone, or improperly done, it is also necessary to determine what pressures caused a highly skilled and well motivated individual to make the mistake. Sometimes the pressures are found to result from an atmosphere of frustration and bickering—a lack of mutual understanding and cooperation between maintenance and operations.

Maintenance exists to support flying operations but maintenance cannot provide effective support in the absence of clearly defined reasonable objectives arrived at by agreement between operational and maintenance staffs in an atmosphere of mutual understanding. Where there is mutual understanding, problems can be resolved without producing the frustrations and pressures that so often lie behind poor practices.

Don't let an accident happen because your interest in flight safety stops short of the total Operations-Maintenance situation.

Our large, complex, and very expensive aircraft maintenance system is designed and operated with one basic aim:

> to provide aircraft and installed equipment which will function satisfactorily so the unit can fulfill its mission.

When this aim is achieved, not only are flying

tasks completed on schedule—they are also completed safely. Unfortunately, in spite of the effort devoted to this aim there may be accidents or incidents in which maintenance actions are a primary or contributing factor. The most disturbing aspect of a maintenance error is not only that it occurs in spite of the many precautions to prevent it happening, but an error frequently involves a man who is highly trained and motivated and who has a good reputation as a mechanic or technician.

Maintenance techniques derive from a comprehensive investigation of the requirement, training to provide the skills, provisions of specialist tools and test equipment, and supervision of the operation by skilled and competent NCOs. When an error is made under these circumstances there is a tendency to assume that the cause was an individual's haphazard attitude or neglect. The problem may not be that simple.

Maintenance error, as with pilot error, requires objective investigation in considerable depth to determine whether there are environmental stresses acting on the individual, negating the benefits of carefully planned techniques, procedures, tools, and supervision. For example, a mechanic required to troubleshoot an engine or a complex piece of avionics equipment knows that accurate analysis depends upon carefully and thoroughly following each step of the procedure. However, there is a limit to his ability to resist continual pressure to meet deadlines. When the pressure is unreasonable he is particularly susceptible to leaping to a conclusion that an apparent symptom identifies the malfunction. In many cases he may be right but in some he may be wrong, with the result that an aircraft is exposed to a hazard because of the lack of correct maintenance action or because an incorrect action was taken. Since such actions derive initially from a well-intentioned attempt to further the unit's flying program it should not be construed as literally neglect.

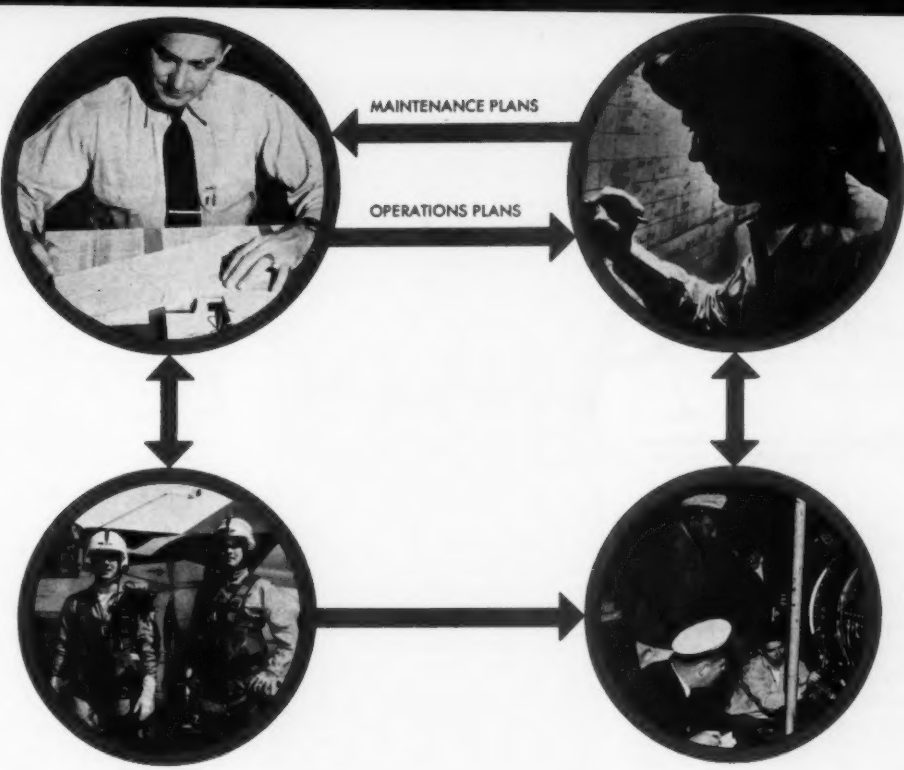
What is the real cause of the problem, and what can be done about it? A peaceful, serene environment with ideal working conditions under completely programmed work scheduling would undoubtedly eliminate the problem. Mechanics and supervisors could ensure that every maintenance action was carried out to perfection. But inherent in flying operations and the supporting maintenance tasks are problems, difficulties, frustration, and unexpected complications. The maintenance organization must continue to function under these conditions. That maintenance people have done so well in the past may lead to an overestimation of their ability to respond. The more complex and demanding the maintenance task the sooner the limit is reached and that there is a limit as demonstrated by our accidents.

We need a means of discriminating between the normal pressures inherent in aircraft maintenance, and excessive pressures which can be resolved before they lead to accidents.

It is generally accepted that the efficiency of any group depends to a marked degree on each man understanding the aims of the organization, and the degree of acceptance of those aims. A maintenance technician, like any skilled person, has his perceptions highly developed as a result of selection and training to ensure that he is capable of observing, analyzing, and logically determining courses of action. These qualities are not confined to his work as a maintenance man; they can also be applied to his work environment. Careful definition of the overall aim of the organization, and in particular the part to be played by the group to fulfill this aim, is essential to achieve harmonious participation by people of this caliber.

Such philosophies may be as indisputable as "truth" or "justice" but to have worth they must be applied to the daily realities. General objectives of most units are quite clear. Aircraft are to be flown at a monthly flying rate to fulfill the unit's role, but what is the *specific* maintenance task for today? Tomorrow? Next week? Next month? Is it to be something vague like "produce as many serviceable aircraft as possible," or "produce a percentage of aircraft serviceable," only to have these aircraft poorly utilized, wasting much of the maintenance effort? Waste of one's effort is always difficult to accept but when followed later by unreasonable demands for increased effort to make up for the waste, these additions to the normal pressures will set up conditions conducive to an accident.

Obviously, the solution to this problem involves a compromise. A plan which produces optimum working conditions for maintenance but which seriously interferes with the flying program is unacceptable. Similarly, an apparently ideal flying schedule which produces intolerable stresses in maintenance or support organizations is also unacceptable. The flying operation, which is the key to the operation of all supporting functions on a station, must therefore be a compromise among the capabilities of the aircraft operators, flying control, servicing crews, airfield maintenance, base maintenance, shops, and so forth. Such a plan can be developed only by the CO, in consultation with command, division, or sector operation staffs. This mutually acceptable plan must satisfy



the operational objectives of the unit, and be capable of meeting the day-to-day variations of changing circumstances. The plan must be thoroughly understood and accepted by all. Once the basic plan is established each section can subdivide its tasks; crews and technicians will know exactly what is expected of them and can plan their work so that it is done most efficiently and safely.

In spite of the wisdom of these programs, people will make errors if the relationship between operations and maintenance results in unacceptable environmental stresses. There are plenty of clues to indicate these conditions—here are some of them:

- Incomplete liaison between operation and maintenance
- Frequent crash programs to catch up with planned flying rates
- Repetitive unserviceabilities that have not been properly fixed
- Poor utilization of available flying time
- Lack of backups in men and machines to meet special commitments
- Inexplicable accidents and incidents.

When some or most of these conditions exist at a unit to any significant extent it is time for action. A superficial assessment may be that more aircraft and/or more people would solve the problem. Unless aircraft utilization is higher than the planned rate it would indicate that fewer aircraft better managed will more likely contribute to a solution. Similarly, more people will not resolve the problem unless conditions already exist that ensure optimum use of the present staff under conditions which encourage them to contribute their utmost.

A vital contribution to flight safety can therefore be made by all concerned, but particularly by commanding officers, chief operations officers, squadron commanders and flight commanders who have direct responsibility for flight safety. Such responsibility entails constant alertness for the indicators listed above, and compliance to up-to-date, comprehensive, detailed agreements developed mutually between the operators and supporting sections. Finally, the plan needs distribution in meaningful terms to that last vital link in the chain of safety—the mechanic who actually does the job.

Only in this way can we be sure that the unit is operating with optimum effectiveness and therefore maximum safety.

—Adapted from RCAF "Flight Comment"

Reader Questions Headmouse Answers

Have you a question? Send it to Headmouse, U. S. Naval Aviation Safety Center, Norfolk, Virginia 23511. He'll do his best to get you and other readers the answer.

Dual Visor Kit

Dear Headmouse:

The new dual visor kit (APPROACH, January, 1966, p. 23) has generated considerable interest among the riggers and flying personnel of VF-143. I have used the dual visor for about a month of night and day carrier operations.

First, I must explain that I find it necessary to use sunglasses or a tinted visor in any bright sunlight condition in order to avoid squinting. Many aviators I know go naked-eyeballs in sunshine with no discomfort; it can be argued that this affords the best chance of seeing the enemy first and is, therefore, preferable. Fine for those who can do it, but I can't—so I use a tinted visor almost continuously in daylight.

I had always flown visor up at night until extensive night carrier operations led me to seek a way to rig a clear visor for added safety in air refueling and to keep the windshield defog airblast off my eyes (the drying effect is uncomfortable and makes lights blur in a night approach). So I need a clear visor at night. Admittedly, there are disadvantages to any visor, particularly at night. The greatest is the reflection problem; another is the annoyance caused by dust, streaks, etc. If we can agree that visors are desirable, both night and day, we can proceed to discuss the dual visor kit within reasonable boundaries. Here is my own evaluation of the dual visor plus some opinions of others picked up along the way:

Suitability: The kit does the job and does it well. I have found only one objectionable feature and this was corrected here: the visor housing projects so far forward that the lower edge, parallel to the front contour of the APH-6 helmet, severely obstructs the wearer's view forward and upward. This is particularly important in air combat maneuvering. We filed the housing contour to follow the contour of the visor bottom, thus opening the pilot's field of view at 12 o'clock high. I recommend that any production visors ordered have housing so contoured.

Comfort: There is no real problem here—with the dual visor installed on the helmet the pilot's head is effectively a little larger so it hits the canopy a little sooner when the seat is raised for landing thus limiting seat upper travel. (This problem is insignificant in my case.) There is some learning required to use the visor knobs rapidly and accurately, particularly the left (tinted) one; at first this seemed like an unnatural hand motion but now I'm used to it. I don't think there's any need to change to left-handed threads!

Durability: My riggers expected the side-driven visors to jam but they have not. The kit has proven very durable and I've had no trouble with it except for knob screws coming loose, a problem which we have experienced also with single visor rigs.

The only changes I would recommend are re-contouring the lower edge of the visor housing and devising some way of retaining the knob screws better. We like the dual visor kit and would like to equip all pilots pronto.

W. SPANGENBERG
CO, FIGHTER SQUADRON 143

▶ The Naval Air Systems Command (BuWeps) has ordered 1400 dual visor kits for fleet evaluation and has recommended that CNO assign a priority Two to this program.

It is expected that this evaluation program will be completed within 30 to 90 days and that regular production buys of this item will rapidly follow.

Thank you for writing—we are passing your comments along to the cognizant Naval Air Systems Command desk.

Very resp'y,

Headmouse

Visor Kit Again

Dear Headmouse:

It probably doesn't happen too often that you are asked for information by a German naval aviator.

In the January 1966 edition of your

New Survival Vest

Several units have passed along suggested revisions and versions to the modified SV-1 survival vest—the most recent being VMF (AW) 235. Their contributions included photos, showing the ingenuity and dedication of the squadron flight equipment shop.

▶ All of this material is appreciated and serves to help advance the state of the art in survival gear. The photos are not being printed because the Naval Air Systems Command (BuWeps) informs us that by the time you read this issue of APPROACH, a BuWeps Clothing and Survival Equipment Bulletin covering local manufacture of the new SV-2 survival vest will be in the fleet. The SV-2 has been tested with ejection seats and live parachute jumps by the Naval Aerospace Recovery Facility, El Centro. It will be the only approved survival vest.

magazine, you talk about a dual visor that can be used one at a time or both together. . . As we often encounter bad weather with poor visibility up here in northern Germany, we just can't afford to use the tinted visor, especially flying low level over sea.

In your article you mention "a well-known equipment manufacturer." I'd appreciate very much if you could give me the name and address of this manufacturer so we could have a sample sent and possibly initiate an order of the required amount.

We receive a copy of your magazine monthly and it is always read with great interest.

H. FISCHER, LT.
NAVAL AIR WING I, 1ST SQDR.
SCHLESWIG, W. GERMANY

▶ At the time the original item appeared in APPROACH, the dual visor kit had not been evaluated and approved by the Naval Air Systems Command. This was the reason for saying "a well known equipment manufacturer." The Navy is now buying the visor kit for evaluation. The manufacturer is Sierra Engineering Company, 123 E. Montecito Avenue, Sierra Madre, California.

Very resp'y,

Headmouse

NB-7E Parachute

Dear Headmouse:

BACSEB 14-62 states that the manual ripcord housing clamp release device shall be used with the NB-5, NB-7 and NB-9 parachute. The NB-7E parachute used in the RA-5C aircraft has static line and slide block assembly. With this arrangement it is not possible to incorporate BACSEB 14-62 on the NB-7E. However, the same hazard exists with the NB-7E as with the NB-5, NB-7 and NB-9 if the pilot is forced to eject. (*The pilot must manually pull the ripcord to detach himself from the parachute risers. The modification in BACSEB 14-62 makes separation automatic in the NB-5, 7 and 9.—Ed.*) In accordance with the current NATOPS manual, flight crews are being briefed to pull the manual ripcord after parachute opening.

I recommend the NB-7E parachute have a manual ripcord housing clamp release device similar to the type described in BACSEB 14-62. Do you know what action, if any, is being taken by BuWeps on this matter?

K. P. HARRED, PR1
RVAH-7

▶ The Naval Aerospace Recovery Facility has already tested a proposed method to provide an automatic disconnect feature on the NB-7E which they found unacceptable for service incorporation. At that time (May, 1966) they reported to the Naval Air Systems Command (BuWeps) that "any further consideration to provide an automatic disconnect feature must begin by complete redesign of the junction block assembly and will require considerable effort, cost and time." The Naval Air Systems Command has no further plans on this project.

Very resp'y,

Headmouse

Operation of Certain Aircraft UHF Receivers During SAR Conditions

Field testing has revealed that aircraft radio reception range of all survival radio beacons is degraded from 30 to 90 percent when cockpit sensitivity (sens) control is adjusted to normal operating setting (no background static) as compared when sens control is adjusted to open the squelch circuit (static present). Also adjusting the sens control to a normal operating setting may degrade receiver sensitivity as much as 6 DB.

During situations where high probability of reception of survival radio transmission is required, recommend all aircraft configured with UHF radio cockpit sens control that the sens control be adjusted to disable the squelch circuit by rotating it to max clockwise position (background static present). Volume then can be adjusted for comfortable listening with no significant degradation of receiver sensitivity.

—ComNavAirLant msg

AJB-3 Gyro Care

Dear Headmouse:

What limitations must be observed relative to gyro movement such as you run into on a flight deck respot?

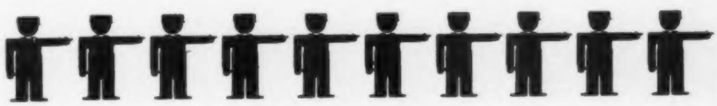
▶ No limitations whatsoever. Any towing that won't damage the aircraft won't damage the gyro. Even severe pitching and rolling of the carrier will not tumble the gyro. Your greatest chance for damage would come if the gyro were turned end for end on being handed down from the cockpit before 30 minutes without power had elapsed.

The safest rule is: Don't handle the gyro for 30 minutes after power is secured. This rule applies to the gyro only—not to the aircraft. For more on gyro care, read the article on page 44.

Very resp'y,

Headmouse

PASS IT ALONG!



Each copy of APPROACH is meant for ten readers.

Frangible-mounted light cluster . . .

Flashing lig

Wheels-up waveoff warning lights are beginning pear

per minute and with equal ON and OFF time. The normal condition of the flashing device is but th

the use of a handheld pickle switch. The lights can also be controlled from the LSO station contr

ment for giving a pilot a wheels-up waveoff will be the permanent type defined here and that the p

a multiple flare system which can be operated remotely by the wheels watch.

...ights? WAVEOFF!

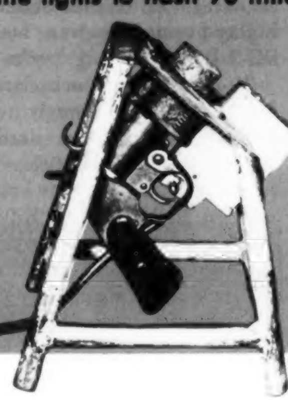
ning ppear on some naval air stations and judging from experiences to date, many pilots do not

know what these mean. Here's the word from NavWeps 51-50AAA-1 of April 1965 which may save you some embarrassment and possibly damaging an airplane. The purpose of wheels-up warning lights is to signal the pilot that landing gear of his aircraft has not been lowered as he prepares for a landing. These lights are placed at six locations, three on each side of the runway starting 800 ft from the threshold and spaced 800 ft apart. The lights, three in a cluster and mounted on frangible couplings are 10 ft outside the runway edge, parallel to each other and perpendicular to the runway center line. See photo upper left. The lights face landing aircraft and are turned in toward the runway centerline seven degrees from a line parallel to the runway and elevated four degrees above the horizontal. A flashing device causes the lights to flash 90 times

e is ut the wheels watch can flash the wheels-up waveoff lights by

ion control tower. OpNav 3710.7C states that the primary equip-

the the permanent installation is made, air stations shall improvise



Remote-controlled flaregun.

All pilots agreed that pick up training was worthwhile.

User Report

Here are the observations of Attack Squadron 64 after participation in a helicopter rescue training drill conducted by Helicopter Combat Squadron TWO Detachment 66 for all Attack Carrier Air Wing SIX pilots. The drill took place during a fleet anchorage in the Mediterranean. Eighty-five rescues were made by HC-2 Det 66 during "swim call."

"*Hard Hats*: Attack Squadron SIXTY FOUR strongly recommends keeping the hard hat throughout the entire rescue sequence. First of all, the hats were used to bail out the PK-2 rafts. Next, the hat with the visor down provided an adequate shield from the bullet-like water spray generated by the approaching helicopter. Finally, several possible head injuries were avoided by the hard hat. Oscillations of the hoisting cable could have caused contact with the helicopter prior to entry.

"*Mk-13 Distress Flares*: Several pilots could not properly actuate a Mk-13 distress flare. It is the belief of this command, after this mass rescue and survival drill, that a great many of the accident report endorsements which indicate that flares did not ignite properly could in reality be attributed to lack of education of the user. Crewmen must know the correct procedures. The common error is to pull the end straight off the flare. The seal has to be twisted until it cracks and then pulled. Attack Squadron SIXTY FOUR recommends that all crew members ignite a Mk-13 for familiarity. Every squadron has an allowance for this. Another possible solution in this area would be a design change in the flare so that it did actuate when the ring was pulled straight off the top.

"*PK-2 Life Raft*: Meteorology indicated that the water temperature was 65°F and the outside air temperature was 67.2°F. Skies were sunny with only 3 kts of surface wind. But when the first pilot entered the water, his comments were quite colorful in describing the rather chilly temperature. Environmental conditions were ideal —well outside the anti-exposure suit envelope but it was cold. It emphasized to us the importance of the pilot being able to inflate and get into the PK-2 life raft. There was little difficulty experi-

from your Flight Surgeon

enced boarding the rafts.

"*Hoisting Techniques*: During a few of the rescues the crewman in the helicopter allowed excess cable to accumulate near the survivor. The loose cable on the surface could have entangled with a parachute or possibly the limbs of the pilot. Crews should be reminded to keep the cable taut."

All pilots agreed that this was extremely worthwhile training, especially those who had never taken part in a real pick-up. The helo detachment was extremely enthusiastic because of the valuable experience they received and the opportunity to requalify crews.

Borderline Temperature

COMBINED air/sea temperature at the time of launch for a night mission was 120° but the F-8B pilot did not wear his anti-exposure suit. A number of complications terminated in a ramp strike. Fortunately the pilot was uninjured.

The investigating flight surgeon noted, however, that the temperature plus the wind chill factor of moderate to high gusty winds that night "could have resulted in an uncomfortable and possibly a disastrous survival voyage if a water landing had been necessary."

"The air/sea combination temperature falls as night falls," he points out. "It is reasonable to assume that a value of 120° at the time of an early night launch is a temporary value that will dip . . . before time for the recovery."

Unyielding

AMONG all the detailed information which has been gathered, sifted and studied from all the available case histories of survival, evasion, imprisonment and escape, one point is repeatedly stressed as the most important single factor in bringing men through it all: a particular kind of mental attitude that is best described as *unyielding*. In other words, coming home again is all in the way you set your mind to it. As important as your hands, your feet, your stomach may be to your continued existence, the No. 1 element in survival is still your *head*.

—NavWeps 00-80T-56 (Rev. 1961)

Know Your Fittings

IN the water after ejecting from an RA-5C, a reconnaissance attack navigator (RAN) had some difficulty releasing his Koch fittings. The investigating flight surgeon reports that it was probably due to unfamiliarity with their operation. Once the RAN realized that the riser fittings were Koch fittings and not rocket jet fittings, he accomplished chute separation easily.

Physiological training units are training with the Koch fittings. Continual follow-up on the squadron level and practice on an individual basis should eliminate any problem. (*See "Koch Fitting Release," p. 34, August 1966* APPROACH.*—Ed.*)

No Mask

A BOMBARDIER/navigator who ejected from an A-6A lost his helmet and sustained bruises of the face and neck. He was not wearing an oxygen mask at the time of the accident and his helmet chinstrap was not cinched tightly.

NATOPS says oxygen shall be used by all crew members from takeoff to landing in combat and combat training jet aircraft.

No Comment

THE bombardier-navigator of an aircraft involved in a midair "habitually flies with his lap belt loose." When he had to eject in an inverted spin, he was suspended five to six inches off the seat. He put his left hand on the canopy and pushed himself back in an attempt to get in a better position for ejection. He then pulled the face curtain with his right hand. Ejection forces caused an acute back strain requiring an estimated three weeks' hospitalization.

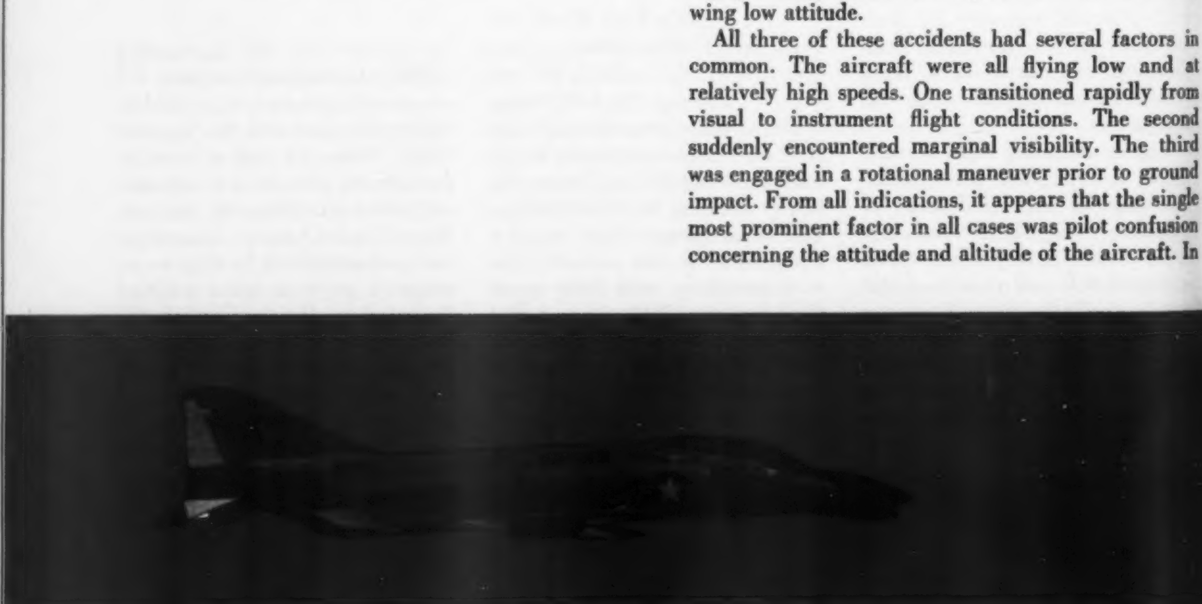
The pilot was briefly examined at the scene of the accident and found to have no apparent injury other than a crushed ego.

Flight Surgeon in MOR

Disorientation Disorientation Disorientation in

An aircraft flying wing at a low altitude pulled up into the clouds and shortly thereafter lost altitude while in a tight turn and flew into the ground. Another aircraft on a low altitude routine test flight suddenly encountered bad weather and struck the ground in a steep bank angle. A third aircraft, orbiting a field, flew into the ground in a nose down, wing low attitude.

All three of these accidents had several factors in common. The aircraft were all flying low and at relatively high speeds. One transitioned rapidly from visual to instrument flight conditions. The second suddenly encountered marginal visibility. The third was engaged in a rotational maneuver prior to ground impact. From all indications, it appears that the single most prominent factor in all cases was pilot confusion concerning the attitude and altitude of the aircraft. In



Flight

By Charles I. Barron, M.D.,
Medical Director, Lockheed-California Company

all cases the pilots lost control of the plane during a critical phase of flight, due apparently to severe disorientation.

This problem is by no means new, having first been encountered over 50 years ago when aviators began to fly under so-called "blind" or instrument conditions. Many terms have been used to describe this condition—spacial disorientation, aviator's vertigo, and lack of aerial equilibrium. In this article, the word "disorientation" is used to include all these terms. Regardless of the term used, the effect upon the pilot is the same and is characterized by confusion, disorientation, and loss of control of the aircraft. When this condition occurs, especially during a critical phase of flight such as low altitude, high speed flying, the result may be disastrous. It is a condition which, while known for many years in aviation, appears to have become more critical with the operation of high performance, highly maneuverable jet aircraft.

Illusions of Attitude, Motion

Of greatest importance in jet aviation are the disorientations associated with illusions of attitude and motion resulting from false sensations originating in the balance mechanism of the inner ear. In the aviator, it is almost always associated with accelerative movements of the head and results in a misconception of motion relating either to the aircraft or to the environment. Not infrequently, an attempt by the pilot to correct for this apparent deviation will result in a loss of control and or altitude.

Since accelerations occurring in aviation may be of varying magnitude, multidirectional, and often unanticipated by even the most experienced pilots, the

problem assumes greatest importance in jet aircraft. This is compounded by low altitude flight, formation flying, or flying under any condition where visual orientation is marginal or absent. Disorientation is a sensation experienced by every aviator at some time in his flying career and may occur regardless of experience and skill. It can, however, be effectively combated and its significance in accident causation minimized by awareness, education and training, and by avoidance in flight.

Basically Land Oriented

Man is basically land oriented and, if healthy, seldom has difficulty in ground orientation. Ground orientation is two dimensional, involving knowledge of distance and direction on a flat surface. Sensory cues which orient man to the ground are complementary and rarely conflicting. Accelerations on the ground are generally of small magnitude, slow in onset, usually constant in application, and rarely conflict with visual and gravitational cues. The eyes and gravity oriented organs of the body such as muscles and certain portions of the inner ear are utilized primarily for ground orientation.

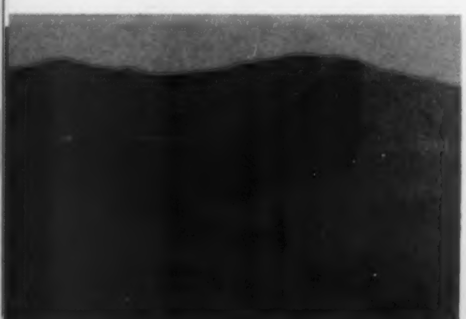
In an aircraft detached from the ground, orientation is three dimensional. The pilot must be aware of distance, direction, and altitude as well as the attitude of the aircraft in relation to the horizon and its position with respect to other aircraft. In the air, visual cues may be very limited and may conflict, especially when visibility is marginal. The pilot is subjected to accelerative forces capable of producing illusions or sensory conflicts at a time when he must maintain dual orientation to earth and aircraft. In the air, the accelerations change rapidly in direction and magnitude, in contrast to ground conditions. Special types of flights requiring operations at low altitude and high speed, aerobatics, formation flying, and gunnery maneuvers impose conditions conducive to disorientation. New sensations such as those imposed by helicopters and vertical rising aircraft may lead initially to confusion. In "blind" flying, the pilot is required to maintain orientation not by the usual primary cues, but by secondary cues obtained from his instruments. To accomplish this, he must learn to ignore body sensations which normally are utilized for ground orientation.

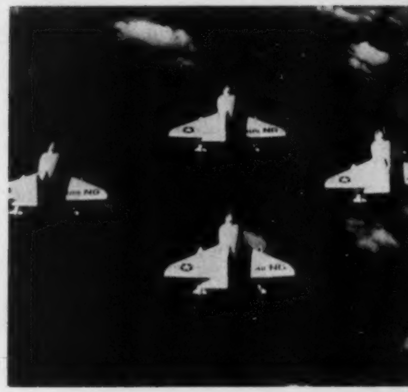
Cue Perception Often Difficult

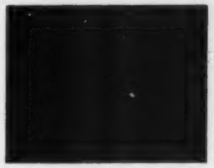
The perception of proper cues and information in flight is often difficult. The pilot's direct cue to the horizontal position is the horizon. False cues may be produced by cloud formations, accelerations, and inadequate light. Depth perception in the vertical plane is extremely difficult to accomplish accurately, especially at night. There may be a lack of conformity between cues. Physical factors such as hypoxia, fatigue, and disease may also seriously alter the reception and interpretation of cues. The body may be incapable of recognizing and responding to very weak stimuli; consequently, gradual or minor deviations or changes in attitude may go undetected. A pilot who has lost direct visual reference or is on instruments requires the following stimulation in order to perceive the necessary deviation:

[redacted]

Thus, under instrument flight conditions, a pilot may not be able to sense a slow climb, roll, bank, or dive.







False Sensations of Motion

At the other extreme, excessive stimulation of the sensory receptors of the body may result in false sensations of motion. On the ground, the major force of gravity acts through the vertical axis of the body. Accelerations in the horizontal and transverse planes are generally small, constant, and slow. They complement visual cues as long as a fixed reference point is maintained. In the air, accelerations produced by centrifugal force are also perceived through the vertical axis of the body, resulting in the downward sensation experienced by aviators in climbs and turns. The three sets of balance canals of the inner ear are positioned at precisely 90-degree planes to each other. They respond normally to angular accelerations of the head or body in the pitch, roll, and yaw planes. Simultaneous stimulation of two sets of canals located in opposite 90-degree planes may result in a sensation of sudden body movement in the third plane, producing what is known as the Coriolis effect. Excessive stimulation of one set of canals may result from continuous whole body rotation when orbiting an airfield, recovering from gunnery dives, and in sustained aerobatics. Under these conditions, the pilot becomes unusually susceptible to secondary canal stimulation by movements of the head 90-degrees out of the plane of whole body rotation. Rapid purposeless movements of the head while in this state are most apt to produce this disturbing phenomenon. Changing radio channels, looking at the floor or ceiling of the cockpit, or shifting one's gaze laterally while experiencing whole body rotation are most conducive in producing this confusing condition.

Results are Confusion, Difficulty

Regardless of the cause of disorientation, the end result is a state of confusion, with difficulty in controlling the aircraft. The confusion may be related primarily to a misinterpretation of sensations arising in the gravity sensing organs, with ultimate difficulty in assessing the true postural alignment. Visual confusion is most apt to occur under conditions where visual reference to the ground is lost. Flying at extremely high altitudes, night flying, flying under marginal conditions of visibility, or any condition where the horizontal reference is lost is most apt to produce this state. Finally, confusion due to stimulation of the balance mechanism of the inner ear may lead to a misconception of body tilt and, at worst, can result in a Coriolis effect.

The importance of disorientation in fast, highly maneuverable aircraft is quite evident. It is one of the more frequent and important known causes of accidents in jet aircraft and is especially encountered in low altitude, high speed flights, in formation flying, gunnery practice, and during aerobatics. It may result from conditions requiring frequent change in frames of reference such as transitioning rapidly from visual to instrument conditions. While all aviators have experienced disorientation at least once, it is not unusual for students to encounter this 20 or more times during their early flight training. It is also of interest to note that among the so-called cause unknown accidents, disorientation is the most probable cause.

Prevention Principles

Prevention of disorientation involves the application of the following principles:

1. A small percentage of all persons are extremely prone to experience this condition. With proper test-

ing, these persons may be identified and eliminated as flight candidates early in the selection procedure.

2. Of greatest importance is the pilot's acceptance that disorientation is a serious problem and can occur regardless of his skill and training.

3. Pilots must fully understand the causes and conditions which lead to disorientation and must develop a very healthy respect for them. Since this is a condition most often associated with inexperience, adequate training using disorientation-producing devices will minimize its potential effect and frequency. It has been demonstrated recently that some degree of adaptation can be developed in ice skaters when exposed to disorientating conditions at frequent intervals. Adaptation or resistance can be maintained by repeated exposures in training programs.

4. Pilots must be aware of the conditions conducive to producing disorientation in flight such as reduced flight time, frequent changes to different types of aircraft, flights made under marginal visibility conditions, night flights, frequent transition from different planes of reference such as from visual to instrument conditions.

5. Proper training in instrument flight and willingness to accept information displayed on instruments is absolutely essential. Pilots must learn to accept instrument readings as being more factually correct than body sensations.

6. Avoid flying half instrument and half visual.

7. If a sudden change in frame of reference is encountered, flight should be maintained in the straight and level attitude for a minimum of 30 to 45 seconds to allow for complete adaptation. Since pilots prefer to fly by direct visual contact, attempts are frequently made to return to visual conditions before the body has adapted to another frame of reference. This is most prone to produce disorientation.

8. Excessive head movements should be avoided when the aircraft is in a state of rotation. Movements of the head within the plane of rotation to maintain orientation may, however, be indicated.

9. Since good health is extremely important in increasing resistance to disorientation, pilots should attempt to maintain physical and mental health at all times by moderation in all personal habits and activities. Hypoxia, excessive vibrations, fumes, fatigue, and recent illnesses are most prone to lower body resistance to disorientation. Drugs known to affect the balance mechanism of the inner ear should be avoided.

10. All incidents of disorientation should be reported immediately to the flight surgeon. An accurate appraisal and understanding of the event is absolutely essential if similar incidents are to be avoided. Frank discussions with the flight surgeon may prevent an accident.

It is evident that while disorientation is a condition associated with aerial flights and an unusually hazardous one in jet aircraft operations, it is one which can be dealt with quite effectively. Acceptance of the problem, willingness to learn its mechanism, and the application of a few simple principles learned in training to operational flight will minimize the problem and may eliminate it as a major consideration in jet aircraft accidents. The individual pilot can contribute intelligently to its control.

BELIEVE YOUR INSTRUMENTS

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Night Solo

The hazards that lurk in the night landing pattern for a student's first night solo hop are ominous enough, but when additional hazards are introduced by nonstandard procedures and poor headwork, disaster is right around the proverbial "corner."

Safe interval is a prime concern in the landing pattern and maintenance of a safe interval becomes even more critical at night.

When a student and instructor in a T-2A realized that their interval was a bit tight, they extended the downwind leg a "tad", but forgot to give the RDO a gear check at the 180 position.

The solo student in the pattern was downwind behind the dual-piloted aircraft and was flying a normal pattern. At the 180 he gave a position report and gear check. The instructor and student suddenly realized their oversight and although at a deep 90 position, they called the 180 with a gear check.

The solo student surmised that the instructor and student were behind him in the pattern and continued his approach—watching the runway.

He arrived on final in a position slightly higher and about 100 ft behind the other aircraft. On short final he spotted the other aircraft as it climbed out after a touch and go. A split second later he encountered its wake turbulence.

"I went to 100 percent power and planned to execute a wave off to the port side; however the turbulence got worse and I was forced toward the deck rapidly," recalls the student. "I barely got the wings level before impact. The port wing tank hit the runway and the aircraft swerved to the left. The aircraft bounced and returned to the ground with the nose gear hitting the arresting gear chain, then the runway edge and collapsed. The starboard gear strut sheared and left the aircraft. The aircraft stopped 195 ft later—still upright resting on the nose, starboard wing, and port main strut. . . . Strike!

A nonstandard landing pattern set up this situation when the instructor allowed his student to extend the downwind leg and call the 180 at a deep 90 position. The solo student, intent on his approach during his first night solo hop failed to maintain adequate lookout for other aircraft in the pattern. The RDO, an experienced aviator and instructor, monitored the two aircraft in the pattern and became aware of the extremis situation when they rolled into final, but he failed to notify the pilots of the unsafe landing interval.

With whom lies the blame?????

Their assignment: parallel the generators of BuNo 123456...

As the last thin rays of a winter sun faded on the western horizon three men walked across the ramp toward a line of P-2s which were squatting on the back line, adjacent to the seawall. These men were electricians, members of the night-check crew. Their assignment was to parallel the generators on Buno 123456. In outward appearance the airplane toward which the men were walking appeared no different from the other *Neptunes* which were parked along side her.

But there was a difference that evening. Several hours earlier a chain of events had been set into motion which would now move swiftly to a climax. Unknown to the electricians, Buno 123456 was similar to a loaded pistol with a hair trigger . . . waiting for the light touch which could set it off.

The chain of events had begun innocently enough. At 1430 that afternoon Buno 123456 had returned from a four-hour training flight. After the engines were shut down, the plane was spotted on the back line and the parking brakes were set by the plane captain, who noted that the emergency hydraulic system pressure returned to normal after the brake was set. The aircraft was then chocked and tied down

RUNAWAY!

at four points with $1\frac{3}{4}''$ sisal line.

At 1500 maintenance control advised the airframes shop supervisor that the hydraulic system on Buno 123456 had been griped because of unusually slow operation. Two men were then dispatched from airframes to correct the hydraulic discrepancies.

To prevent inadvertent pressurization of the main and emergency hydraulic systems while working on the aircraft, one of the men placed the Main Hydraulic System Bypass Valve in BYPASS, depressurized the Emergency Hydraulic System by pressing the Manual Bypass Button at the Emergency Hydraulic Panel, and placed the Emergency Hydraulic System Control circuit breaker in the off position. It was then determined that the Main Hydraulic System Accumulator was at fault, having developed an internal leak. At the direction of the shop supervisor one of the men removed the accumulator and then capped off the hydraulic line (fingertight) that led to it.

After completing this task the mechanic headed for the shop to report to his supervisor. It was almost secure time and he was probably in a hurry. However, Buno 123456 had been left in a potentially

hazardous condition:

- The main hydraulic system was depressured.
- The hydraulic line leading to the main hydraulic system accumulator had been capped off only fingertight.
- The emergency hydraulic system control circuit breaker (switch type) had been left in the off position.
- The emergency hydraulic system was depressurized.

The mechanic also walked away from Buno 123456 without placarding it, although he knew that placards were available and understood that this was a situation in which they would be required.

Upon reaching the shop, he simply informed his supervisor that the accumulator had been removed and the line capped off. He did not tell the boss of the condition of the aircraft as he had left it.

At 1530 the mech secured.

Closer supervision was needed at this point. The airframes shop supervisor did not insure that the aircraft had been left in a safe condition, to wit, chocked, tied down and placarded. Later on that afternoon, he turned over an incompleted job (on Buno 123456) to the night crew without actually having checked the work that had been accomplished.

No one approached Buno 123456 for the next $1\frac{1}{2}$ hours. Her true condition was a secret to all but one person as the remaining minutes of winter daylight ticked away into history.

At 1700 three electricians on the night-check crew arrived at Buno 123456 to parallel the DC generators. *Neither the electricians nor their shop supervisor were aware that work was in progress on the hydraulic system of this particular aircraft.* Moreover, maintenance control had not been informed that the electricians were going to work on the aircraft, and consequently, had not released it for turnup. In short, maintenance control did not have control over these separate maintenance endeavors in order to coordinate them.

The senior man in the group inspected both reciprocating engines, observed that the four-point tiedown was in place, and then entered the aircraft with one of the other men. The third man remained on the ramp to act as fire watch and outside observer.

As a whole, exterior inspection of the aircraft was cursory. Many items that should have been checked were either overlooked or deliberately skipped. One of these items had to do with the position of the chocks. Were they in place or not? Had he been asked the question as he climbed up to the flight deck, the senior electrician could not have given a confident reply . . . but in a short while the answer would be obvious.

While crawling through the nose tunnel enroute to the flight deck the senior electrician passed both the main and emergency hydraulic system panels. A glance at the position of the manual bypass valve on the main hydraulic system panel might have warned him that something was amiss, but he moved on by without stopping. Thus, Buno 123456 remained cocked.

Upon reaching the flight deck the electrician inspected the circuit breaker panels, but found nothing amiss. While thus engaged, he looked at the emergency hydraulic pump switch and thought it was in the "on" or "up" position. Again, however, had the question been posed as he entered the cockpit, a confident reply would not have been forthcoming. Thus, another opportunity to uncock Buno 123456 was missed.

The reciprocating engines were started without reference to the prestart checklist, a clear departure from standing operating procedures. Item 24 on this checklist requires that the emergency hydraulic pressure be checked—UP.

After the engines were running, the electrician did not refer to the pretaxi checklist, a procedure which was also required by directive. Item 1 on this checklist required that fuel, oil and *hydraulic* pressures be checked—NORMAL.

This man, who was recognized as an outstanding petty officer, had considerable experience in turning up P-2s . . . so much experience perhaps that the task had become familiar and routine to him. Procedures which were at one time "by the book" were on this particular night characterized by laxity and casualness.

About 15 minutes after the engines were started one of the men inside the aircraft left the cockpit and moved aft to the radio compartment to parallel the generators. After he had reached his position and established ICS contact the senior electrician in the cockpit began applying power to the engines.

As the RPM was passing 1300, he felt the aircraft move forward.

The procedure for paralleling the DC generators requires about 1600 rpm. Since the electrician stated later that he definitely did not exceed 1300-1400 rpm, the 4" x 4" chocks of the type used by the squadron were most probably not in place.

In a subsequent test, chocks of this type held an unbraked aircraft in position until a power setting of

2200 rpm and 34″ MAP was reached, and then it jumped the chocks. These chocks had worn edges and were fitted tightly under the wheels. In another test, these same chocks were placed about 4 inches in front of the wheels to simulate a sloppy placement. This time, the chocks held an unbraked aircraft until a power setting of 2100 rpm and 32″ MAP was reached.

As the P-2 continued forward, breaking the tie-down lines, the electrician pulled back on the throttles, then released and reset the parking (emergency) brake, but the airplane continud to roll. *Parking brakes were not available because the emergency hydraulic pump was not operating and the emergency hydraulic system was depressurized. Static brake pressure had been released just after the engines were started, when the electrician had recycled the parking brake.*

At this point the electrician released the emergency brake again and then applied the main brakes. The main brake pedals bottomed out as the aircraft continued to roll. *Main brakes were not available for several reasons:*

- *The main hydraulic system was bypassed, or depressurized.*
- *The main hydraulic system line was capped off only fingertight when the accumulator was removed, thus permitting hydraulic fluid to escape under pressure when the engines were started.*

Buno 123456 was now rolling clear of its parking spot and the electrician began manipulating the throttles in an attempt to both stop the aircraft and stay clear of the other P-2s on the ramp.

Reverse thrust stopped the initial forward roll, but the amount of power applied was a little too much and the airplane began rolling backward, toward the seawall. Forward thrust saved the day but then the big bird started rolling forward again, on a collision course with another P-2, which was parked ahead and slightly to the right. A heavy burst of reverse was then applied, which stopped the forward motion once more but Buno 123456 then started back downhill toward the seawall again.

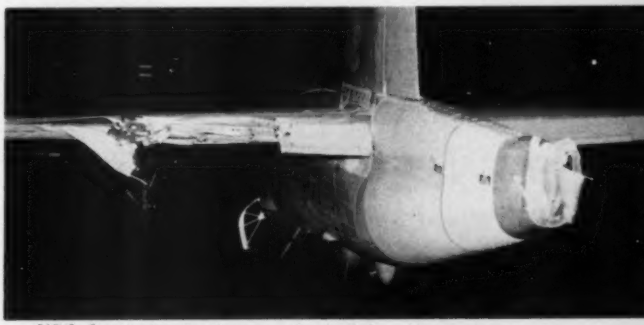
This back and forth sequence, accompanied by heavy and understandably frantic bursts of power, became progressively violent, and the aircraft gradually began to work clear of its parking spot, cocking its nose about 90 degrees to the left in the process. The P-2 which had been ahead and to the right was now behind and slightly to the left of Buno 123456. During one of the rearward rolls, the inevitable happened—the electrician came on with forward thrust a little too late and the tails and MAD booms of the two aircraft crunched.

This last application of power, though a bit tardy, was again very healthy, and Buno 123456 broke free of the entanglement and lunged upslope, veering right toward a clear area of the ramp. At this time, the harassed electrician decided to call it a day (or night) and secured both engines.

As the *Neptune's* forward momentum slowed, several persons were chasing up the slope after it, hoping to get chocks under the main mounts just as their forward motion ceased. They didn't catch up in time, however, and the hapless P-2 started back down the ramp, arcing slowly to the left as it picked up speed.

During this final roll, linemen threw chocks under the starboard wheel twice, but the combination of a sloping ramp and the aircraft's momentum was too much in each case, and it rolled over the chock without a noticeable pause.

Buno 123456 finally came to rest with the trailing edge of its starboard wing buried in the nose of another P-2.



With frantic bursts of power the brakeless *Neptune's*

back and forth sequence became more violent. . .

Two of the aircraft received Delta damage. The third received Charlie damage.

On the brighter side, no one was hurt and aircraft

damage was comparatively light. Fortunately, the engine and fuel cell areas of the three damaged aircraft were unscathed. Had they been damaged during one of the collisions, a fuel fire might have erupted, causing a far more serious, and possibly tragic, outcome.

In summary, the contributing cause factors were:

- The aircraft was not red-tagged to indicate an inoperative hydraulic system.
- Improper job turnover—Maintenance Control did not coordinate shop efforts.
- Failure to use NATOPS checklists for preflight and turnup.
- Improper chocking of wheels and tie-down.
- Complacency, overconfidence and hurry were all present in this mishap.

While there were sufficient written procedures, if followed, to prevent just such a mishap, these points are reemphasized so it won't happen to *you:*

- Always placard an aircraft whenever a system is incapacitated.
- Pass the word, in writing, on job turnover. Remember, two-way communications within the maintenance department is necessary for flow of information up and down the chain to keep Maintenance Control informed of work in progress.
- Preflight for turnups—use the NATOPS checklist.

Whenever an aircraft's system is incapacitated—red tag it!

Crud in the Hydraulic System

What the Mechanic can do to Help

Bits of rubber, metal shavings, aluminum or bronze chips, hunks of filings, and other junk are unwelcome visitors in the hydraulic system of any aircraft. It's the sort of gook that, in at least one case, has been responsible for a million-dollar accident.

The jury is still out on whether, at this point, hydraulic systems contamination falls into a major problem area. But there have been enough suspicious accidents and incidents to point a finger in that direction. And there are a lot of "undetermined" causes which might well be hung on contaminated systems.

In one such accident, the aircraft touched down and rolled normally along the centerline until the first brake application. The left wheel promptly locked and blew the tire. This jerked the aircraft off the runway, where it wound up with "substantial damage." Metal shavings and other particles were found in the hydraulic system return line filter, and the shuttle valve of the brake control valve was found to be scored. This scoring, in the opinion of the investigators, could have been caused by the foreign matter, resulting in binding of the control valve. In turn, this would have locked the left wheel.

Crud in up-and-down sequence valve prevented extension of landing gear.

In another such affair, the right main gear would not extend. The pilot landed on a foamed runway. Steel and aluminum particles were found in the up-and-down sequence valve of the right main gear.

If contamination accidents and close-call incidents cannot be prevented by design or mechanical changes, it would seem that the time has come for a closer look at flight line procedures. The big problem has always been foreign particles introduced by self generation within the system itself, or by improper maintenance.

Every hydraulic system component having moving parts contributes, in some degree, to self-generated contamination, particularly during the break-in or wear-in period. Hydraulic pumps, because of the motion and speed of operation, are considered to be

the worst offenders. In general, self-contamination can be controlled only by scheduled replacement of filter elements and by flushing the system when required.

Pump cavitation is another source of self-generated contamination. The collapse of air bubbles that occurs during the cavitation process results in the chipping or erosion of metal parts. These bits of metal are then released as foreign matter in the system. Cavitation can be controlled by proper bleeding of aircraft systems, and by making sure the hydraulic reservoir air pressurization system is functioning properly. This will provide an adequate pressure head to the pump inlet, reducing the possibility of cavitation.

Maintenance-generated contamination is something else again. For example, the normal procedure at some bases when hydraulic pump failure is experienced, is to replace the pump, check out the system, and turn the bird loose. Nothing is done about inspecting repeat failures.

When components are removed from the aircraft, the disconnected hydraulic lines are not always capped. Along this same line, quick-disconnect fittings are not always protected when engines are pulled out. Then, as a further aid to contamination, the fittings are sometimes reconnected without wiping off the accumulated dirt. Other aids include hydraulic reservoirs being serviced from open containers in dirty or dusty areas.

Dirty tools, such as screwdrivers, may be used to open sealed hydraulic fluid containers, or the containers may be opened from the wrong end. It is also false economy to save the small quantity of fluid that may be left over from servicing an aircraft, with the idea of using it in another bird, unless strict precautions are used to keep the fluid clean.

Here are some points for supervisors to apply to their contamination control program.

- Are hydraulic system filter elements replaced periodically?
- Do all hydraulic specialists know the location of all of the filters in all the aircraft they service?
- Do your people always check the air filter installed in the hydraulic reservoir air pressurization system?
- Is there a systematic procedure in use for checking hydraulic system contamination?
- Is the ground service equipment adequately maintained?
- Are the filters checked regularly?

For the most part, an aircraft system is only as clean as the equipment used to service it.

Contamination can be kept to a minimum if the following precautions are regularly observed:

▶ Always check the lines for evidence of self-generated contamination in the event of hydraulic system component failure. Flush the system if and when required, and be sure the flushing procedure is adequate. This is especially important in the case of hydraulic pump failure.

▶ Be sure, when a system component is replaced, that open lines and fittings are capped until the replacement is completed.

▶ Insure that quick-disconnect fittings on both aircraft and ground servicing equipment are protected when disengaged.

▶ Whenever possible, service the aircraft hydraulic reservoir with a pressurized unit. When this cannot be done, make sure that precautions are taken to prevent dirt, lint, and other foreign matter from entering the system at the time of servicing.

▶ Always open fluid containers at the unpainted end.

▶ Be sure to inspect all filters periodically; and replace, rather than clean, all paper filters.

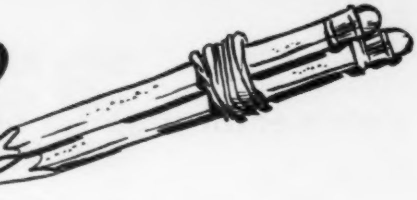
▶ Set up a systematic procedure for determining flushing requirements.

▶ Establish a continuing program for ground equipment maintenance similar to that for aircraft.

There isn't a known amount of contamination that a hydraulic system will accept and still keep going. Contamination control depends on maximum system cleanliness at all times. Any outside contamination should be considered too much. Govern your maintenance actions accordingly.

Cleanliness during maintenance is a must to avoid hydraulic system contamination.

Why Torque?



Without limits on the torque applied to important structural threaded parts, either the parts would not be tightened enough to provide rigid joints, or the application of too much torque would overstress the parts.

The fatigue life of a part depends on the percentage of load change encountered during operation. The lower the percentage the longer the fatigue life. Therefore, the higher the initial tension in a threaded fastener because of initial torque application, the longer will be its fatigue life. To better understand this, take a rubber band and note that it stretches in direct proportion to the amount of pullup to its useful (elastic) limit. Any change in stretch shows a corresponding change in load: a constant amount of stretch shows a constant load. Now, wrap this band tightly around two pencils. Assume that they are being held together with a force of two pounds. If you try to separate them with a force of one pound, what happens? Nothing that one can see—the pencils don't separate; the rubber doesn't stretch and the rubber doesn't "feel" the pull. Why? The rubber band is preloaded to a greater force than you applied. The one-pound pull only reduces the pressure between the pencils (from two pounds to one pound) and the rubber doesn't know the difference. It will not stretch further until the pull is greater than two pounds. If the band is made of metal instead of rubber, and a load exceeding two pounds is applied intermittently, it will eventually fail from fatigue. Fatigue life will be greatly increased if the preload is equal to or greater than the alternating load imposed.

The solution to this problem sounds simple. Just apply and maintain proper preload. But in actual practice a few complications arise. First, the torque method, which is far from foolproof, is used to obtain preload on the bolt. Obviously, the more you tighten the nut, the more you pull the bolt. But will all the bolts holding the part get the same pull if each nut is tightened the same amount. Only until conditions that resist the nut from turning are equal—thread cleanness, condition of the threads, condition of the mating surfaces . . . . It is important to keep these conditions as uniform as possible by giving close attention to the physical condition of the mating parts and abiding by recommended assembly procedures. The torque method has its drawbacks, but it is much better than guesswork and the best method generally available in the field. It's the one to use until a better method comes along. But while using it keep in mind that it's preload of the stud or bolt that we are after.

Now let's consider the application of too much torque. The result in this case is more apparent.

When a nut is tightened too much it usually winds up in the mechanic's wrench and the problem is simply a matter of replacement.

The application of torque given in Column 2 of the torque table will develop about 40,000 psi in the bolt. Column 3 is simply 60 percent of the values given in Column 2 and will develop about 24,000 psi in the bolt. These torques are intended for bolts load-

Torque Table

These torque values are derived from oil-free cadmium plated threads

Tap Size	Tension Type Nuts AN365 AN310	Sheer Type Nuts AN364 AN320	90,000 psi Bolts AN365 AN310	(60% on Column 4) AN364 AN320 Nuts
8-36	12 15	7 9	20	12
10-32	20 25	12 15	40	25
1/4-28	50 70	30 40	100	60
5/16-24	100-140	60 85	225	140
3/8-24	160-190	95-110	390	240
7/16-20	450-500	270-300	840	500
1/2/20	480-690	290-410	1100	660
9/16-18	800-1000	480-600	1600	960
5/8-18	1100-1300	600-780	2400	1400
3/4-16	2300-2500	1300-1500	5000	3000
7/8-14	2500-3000	1500-1800	7000	4200
1-14	3700-5500	2200-3300	10000	6000
1-1/8-12	5000-7000	3000-4200	15000	9000
1-1/4-12	9000-11000	5400-6600	25000	15000
8-32	12 15	7 9	20	12
10-24	20 25	12 15	35	21
1/4-20	40 50	25 30	75	45
5/16-18	80 90	48 55	160	100
3/8-16	160-185	95-100	275	170
7/16-14	235-255	140-155	475	280
1/2-13	400-480	240-290	880	650
9/16-12	500-700	300-420	1100	900
5/8-11	700-900	420-540	1500	900
3/4-10	1150-1600	700-950	2500	1500
7/8-9	2200-3000	1300-1800	4600	2700

Continued

...a loose joint is more detrimental than an overtorqued fastener.

ed primarily in shear. Columns 4 and 5 list maximum allowable tightening torques. These torques are intended for bolts loaded primarily in tension. Column 4 values develop about 90,000 psi in the bolt; Column 5 values develop about 54,000 psi.

Obviously, the torque limits given in Columns 2 through 5 are all within the static strength of the 120,000 psi minimum ultimate-strength AN bolt. What is the reasoning behind the application of one or the other of torques? The answer is that when an airplane is in flight or is landing under certain combinations of shear and tension, loads on a fastener, the tension load originally built up by torquing the bolt may be increased by externally applied loads. In such cases, the lower range of torque is used so that the loads together will still not add up to the ultimate strength potential of the fastener. The higher torque values are standard for high-strength bolts but are used for AN bolts only after it has been first ascertained that no critical combination of shear and tension loads exists that might exceed their ultimate strength. These special torque requirements are called out in the Maintenance Manual for the airplane affected. Generally, if Engineering believes that rigid joint will result from the application of the low range of torque (Columns 2 and 3) and there is no apparent reason for higher values, the low range is used even though the fastener may be strong enough to withstand the high limits (Columns 1 and 3). It is expected that in any case where an installation does not result in a rigid joint, the discrepancies will be called to the attention of Engineering by field reports so that the possibility of raising the torque limits may be investigated.

From the mechanic's viewpoint, this simply means that he need only be concerned with the standard torques values given in Columns 2 and 4 for AN bolts, the values in Columns 4 and 5 are primarily used as standards for high strength bolts and when called out in the Maintenance Manual for specific applications. When tightening castellated nuts on bolts it is possible that the cotter pin holes will not line up with the slots in the nuts for the range of recommended installation listed in Columns 2 and 3. In each case a nut may be overtightened just enough to line up the nearest slot with the cotter pin hole so long as the limits in Columns 1 and 5 are not exceeded.

In some instances, as exemplified by hinge bolts on control surfaces which connect a male and female joint, which has clearance between the male and female members, application of torque above the specified may distort or break the attached parts. Therefore, when a torque range less than the range given in the torque table is specified, the upper limit of the range should not be exceeded.

A qualification expressed in the torque table is tolerated here. Unless the part is a deliberately lubricated environment torque values are for unlubricated threads. Lubricating threads is equivalent roughly to increasing the the upper torque limit since less of the torque is restricted by friction. On unlubricated bolted connections tightened from the nut side, about 50 percent of the torque is used to overcome friction. The remaining 50 percent is responsible for the residual tension imparted to the bolt.

To summarize, a loose joint is more detrimental than an overtorqued fastener. It is better from a structural point of view to overtorque the fastener with caution, since immediate damage is the most serious consequence.—*NAA "Service News"*

Just using a torque wrench doesn't guarantee success.

YOU'VE GOT TO USE IT CORRECTLY!

NOTES

and comments on maintenance

GSE & Betsy

LT D.E. Bakko, Miramar's Ground Support Equipment Officer, prime mover of Betsy Program, demonstrates award vehicle.

THE slogan "Better Equipment to Serve You" is symbolized by an unusual vehicle called "Betsy" at NAS Miramar. Betsy is part of a program designed to reduce maintenance and damages to Ground Support Equipment (GSE) through better care and operation of such equipment.

Betsy is a supercustomized flatbed—a fringed-top surry—which is used as an incentive award to Miramar-based squadrons for the best GSE care. The award is presented to the winning unit selected by a three-man board representing CFAD, PWD and GSE. Judgment is based upon a 60-day period—the winning unit keeps Betsy for 60 days.

The program also enlists the aid of a line patrol. The GSE Division patrol monitors line operations to prevent unsafe and improper operation of GSE. It was pointed out that often major repair results from equipment abuse ranging from failure to maintain proper oil and water levels to wiring open governors and hotrodding through line and squadron areas. Formal instructions and line monitoring help gain the maximum objectives of the support equipment training program.

There are several desirable features associated with winning Betsy. First, there is the prestige of being known as a well-organized squadron capable of putting forth the effort to win. Second, there is the pleasure of operating a machine whose privileges are recognized. The vehicle has unrestricted parking and use. This means it can be taken to the mess hall, Navy Exchange and the like, with parking privileges near the entrance.

A Ground In Time

AN eager crew was pulling minor maintenance out of doors in spite of a slight drizzle and considerable thunder and lighting. The engine mechanic, up to his ears in cowling, asked his helper for a wrench and was reaching back for it when a bolt of lightning struck the tail of the aircraft. He and others in the immediate vicinity were knocked to the wet ground, each with hair standing on end and a fine high voltage tingle throughout. Taking shelter, the crew justifiably declined to do any more work on the aircraft until the squall had run its course.

Examination of the aircraft found it thoroughly and properly grounded with neither a circuit breaker open nor a fuse fused. Grounding had paid off handsomely—no fire, no damage to the bird, and only a jolted crew now a firm believer in the advantages of keeping clear path of small resistance for static.

—Flight Safety Foundation Bulletin

Pass it Along

Does your plane captain see Approach regularly? Spot checks indicate that pilots in many squadrons see every issue, but mechs sometimes do not! Because Approach contents are selected with the safety needs of all naval aviation personnel in mind, please help see that the line shack and maintenance shops receive their share—they just might read something that will help you!

Continued

AJB-3 Gyro Care

Like a midair collision, a stuck gyro can ruin your whole day. That's why pilots, technicians and supply support people should give the gyro plenty of TLC (tender loving care).

An overhaul activity which evaluated gyro reliability came up with some very interesting results. During a six-month period they received 31 gyros for their first overhaul. These had been in service in the fleet from 20 to 40 months. The average life of those 31 gyros was 24.8 months. But an evaluation of all gyros overhauled by that activity to date indicates the average life is slightly less than 15 months. These include:

- *Tumbled gyros that resulted from the guy on the end of the stick throwing the wrong switch at the wrong time.
- *The gyros that are mishandled by technical personnel—a gyro that has been operating needs 30 minutes of rundown time before it is taken to or from a test bench.
- *Gyros that are rejected due to faulty test equipment— rejection of good gyros just because they were not adequately tested is costly and wasted effort.

A gyro is a delicate instrument. When it is tired and ready for overhaul, continue to handle and pack it like a precision instrument. It can be overhauled and can give service as good as a brand new unit. Excessively rough handling or poor packaging can ruin a perfectly good gyro to the extent that it is unsalvageable. While few gyros receive such treatment it is corollary that the rougher the handling and the poorer the packaging, the shorter the life of the gyro and the more expensive the overhaul.

The AJB-3 gyro is designed to withstand 15G's. Arrested landings can be made all day long with a carton of eggs in the cockpit without breaking a single egg, but drop one of those eggs three inches onto a test bench and that's it brother. The same reasoning applies to a gyro. Remember, pilot, technician and supply support man, when it comes to gyros—give it plenty of TLC. *See Headmouse, page 23 for more on this subject*—Ed.

Do You Agree . . .

. . . every maintenance man has an individual responsibility for accident prevention . . .

. . . responsibility is the minimum acceptance: that accident prevention is a duty you owe to yourself and the men you work with and to those who operate the missiles and fly the aircraft that you work on . . .

. . . you cannot live entirely alone: on or off duty, your attitudes and the things you do are felt by many people. You can take pride in their successes as they do in yours and you must often pay the price of their errors, as they must often pay for yours . . .

. . . whenever you do less than your best, you may risk the lives of others and you have surely failed yourself . . .

. . . accidents can be clearly related to thoughtless or forgetful moods and usually follow close on careless acts . . .

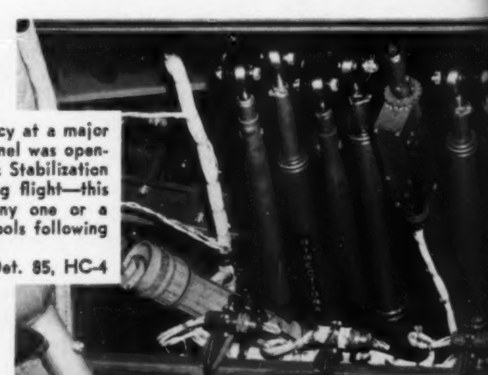
. . . maintenance-induced accidents can be eliminated when your pride in your work becomes so much a part of your that it controls your every maintenance action . . .

. . . to live and work safely is not a special freedom that you are entitled to; it is an end to be attained and then worked at every day . . .

. . . to prevent injury to yourself and others is a universal obligation, the ultimate measure of your individual responsibility . . .

If you do, you're a maintenance pro.

—Quoted from USAF Aerospace "Maintenance"



TOOL ACCOUNT—Following repair of a cyclic pitch loss discrepancy at a major air station, a UH-2 was flown back to the ship. When the control tunnel was opened a flashlight was found adrift in the ASE cadillac unit (Automatic Stabilization Equipment). Fortunately the light did not fall from its perch during flight—this photo reveals a serious hazard in that it could have jammed any one or a number of controls. The lesson here is to account for all of your tools following any job on any aircraft.

—LCDR C. C. Witkowski, O-in-C, Det. 85, HC-4

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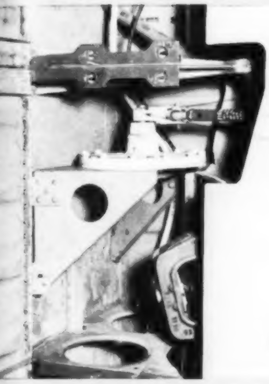
MURPHY'S LAW *

P-3A MURPHY

A routine calendar inspection disclosed that the upper rubber viscous damper arm assembly (PN 834197-3) had been installed 180 degrees out of proper position. See photo 1. Rudder forces then caused the upper push rod (PN 923069-1) to break the guard plate (PN 908914-11). See photo 2. Improper rigging of the upper and lower viscous dampers caused binding. This Murphy was detected during the fourth calendar inspection since Navy acceptance, and the first since squadron acceptance. Although there is a requirement for examination of this assembly during each calendar inspection, the original installation is suspected of being faulty because the paint had not been disturbed.

Contributed by VP-44



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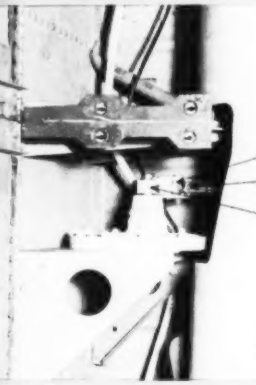

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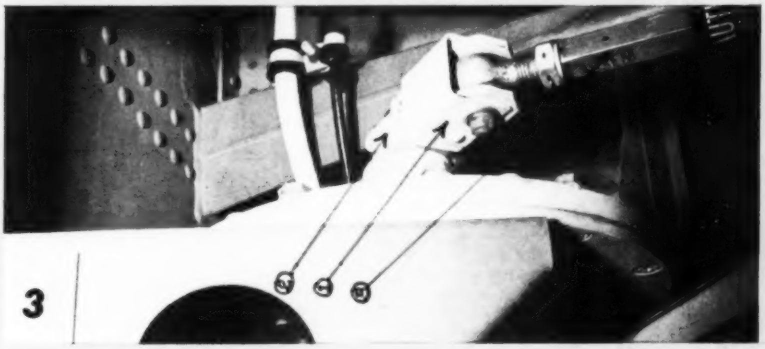

3

Photo 1: Rudder, full right. Arm (3) installed 180 degrees from normal position allowing viscous damper arm (2) to break guard plate (1). Photo 2: At full left rudder, damper arm (2) forced its way through guard plate. Photo 3: Arm (3) correctly installed. Viscous damper arm (2) cannot make contact with guard plate (1).

* If an aircraft part can be installed incorrectly, someone will install it that way!

APPROACH welcomes letters from its readers. All letters should be signed though names will be withheld on request.
Address: APPROACH Editor, U. S. Naval Aviation Safety Center, NAS Norfolk, Va. 23511. Views expressed are those of the writers and do not imply endorsement by the U. S. Naval Aviation Safety Center.

Letters

"No one gets ready for an emergency in a moment. What a person does in an emergency is determined by what he has been doing *regularly* for a long time"
—Courtesy National Safety Council

Torque Wrench Calibration

Norfolk —BWR Pomona ltr 2750 of 25 Aug 1965 indicates the intent to revise the calibration interval for torque wrenches to 3 months vice 1 month as now required by NavWeps 17 35MTL 1 of 15 Mar 1965.

In view of the information contained in the Aviation Safety Center's "Weekly Summary," issue of 11-16 April 1966, it does not appear feasible to lengthen the calibration interval of torque wrenches. With increasing mishaps due to improper torquing, whether from human error or out-of-tolerance tools, it is imperative that every effort be exerted to minimize this condition. Therefore, it is recommended that the calibration interval remain one month.

T. F. SPRUILL
BFRLANT

• You're so-o-o right. NASC's most recent statistics indicate a sharp increase of reported mishaps attributable to improper or non use of torque wrenches. Although the reports indicate only improper application of torque, it can be assumed that in many cases, unqualified wrenches were used.

In view of the necessity for constant use of torque wrenches—frequent usage requires more frequent calibration—NASC has officially endorsed the recommendation that the present 30-day cycle be continued.

For more on torque, please turn to page 41.

UR Clarification

Philadelphia—"UR Trouble," on page 22 of the May issue indicated that naval aviation personnel are not fully aware of the use and preparation of the Unsatisfactory Material/Condition Report (UR), NavWeps Form 13070/5.

The total implementation of the UR system throughout the Navy, on 1 Oct 1965, provides for a means of reporting special and safety situations concerning defective materials, circumstances that could result in injury to personnel, or situations that could contribute to an accident or incident. In addition, the UR also provides for reporting discrepancies in design, maintenance, technical data, quality control etc. Because of this, the user has complete latitude in the area of reporting deficiencies of *any* materials used in operations or maintenance of aircraft. Consequently, the UR may be utilized for reporting all types of material whether they are consumable or not.

Index Now Available

The annual index for Volume 11 of APPROACH (July 1965 through June 1966) has been distributed with "Crossfeed." This listing includes issue and page number referring to major articles dealing with a baker's dozen sub-areas to the APPROACH sections on Flight Operations, Aviation Medicine and Survival, and Maintenance. Additional copies of the 1965-1966 index are available on request—to both Navy activities and individual paid subscribers—from Commander, Naval Aviation Safety Center, Attn: Safety Education Department, NAS, Norfolk, Va. 23511.

- Training and Training Devices
- Ground Operations
- Weather
- Aircraft by Model
- Maintenance (including Murphy, FOD)
- Flight Operations
- Ejections and Parachutes
- Carrier Operations
- Command and Supervision
- Instrument Flying
- Aeromedical Aspects
- Pilot's and Aircrew Condition Factors
- Rescue and Survival
- Ditching
- Helicopter Operator

Flight Test Checklist Made Handy

Kneepad-size transparent plastic envelopes contain deck of flight test cards and flight profile. Grease pencil notations over checklist items can be erased after logging, permitting infinite reuse of the deck. Envelopes are waterproof yet permit easy replacement of outdated cards. Stock No: 0141-308-9800.

Contributed by VP-5

Each UR set is provided with an instruction sheet for the preparation of the UR form. Included is a brief explanation delineating types of conditions that may be reported under the UR system. For a more detailed outline of conditions involving defective materials, Chapter 15 of BuWeps Inst 4700.2A should be reviewed. Chapter 15 of BuWeps Inst 4500.2A will be revised in the very near future to reflect use of the UR form vice AmpFUR.

In the event that any problems exist in the preparation of UR forms, inquiries should be directed to Commanding Officer, Naval Air Technical Services Facility (MR), for clarification.

A. MENCIN
NATSF

Three Thousand Words??

Ent Air Force Base, Colorado: Would like to reproduce the photograph of the wedding ring welded to an open wrench, which appeared in June issue of APPROACH, in the Industrial Safety section of the Headquarters ADC Accident Prevention Handbook. To adequately copy this photo, a glossy print will be needed. Can you supply the print?

MAJ K. L. PATRICK, USAF
CHIEF, GROUND SAFETY DIV.

• This same photo has been requested by several other publications. A glossy print is on its way to you.

Caterpillar Club

Richmond, Va.—I am seeking some information in regards to the Caterpillar Club, mainly their address. This is an outfit for those who have made emergency bailouts. Since I had to do this, I have wanted to get in touch with them. Any information would be appreciated.

T. G. SMOAK
1/LT USAF

• The address of the Caterpillar Club, Inc., is P.O. Box 1328, Trenton, N. J. You'll probably get a pin and a certificate for the den. Now if you had been in a Martin-Baker seat equipped aircraft, you could also have been eligible for a beautiful blue tie from Martin-Baker Company of England.

We are most glad you survived your ejection.

Ear Plugs In Flight

NAS Miramar—Several aviators in my squadron have approached me with questions regarding the use of earplugs when flying to attenuate radio static. I have advised them against using them because of the possibility of the plugs being jammed deeply into the ear canal during a descent. I feel this is a practice which should be discouraged because of the possibility of developing intense ear pain with subsequent deterioration of flying if the plugs do become deeply imbedded in the ear.

M.D.

• We strongly agree, not only because of the danger of the ear plugs being sucked in upon descent but also because of the diminution in intensity of actual communications as well as static.

Sea Survival

Randolph Air Force Base, Tex—We are very interested in using the article "Psychological Aspects of Sea Survival," which appeared in the March issue of the APPROACH. Permission and assistance in obtaining the photographs which illustrated the article is also desired.

CAPT A. G. LISLE, JR., USAF
EDITOR USAF INSTRUCTORS JOURNAL

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Our product is safety, our process is education and our profit is measured in the preservation of lives and equipment and increased mission readiness.

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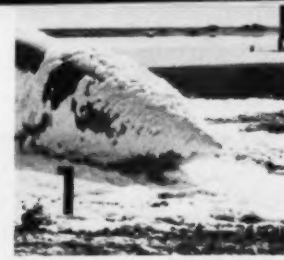

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hot WX is upon us...

Why do naval aircraft (Army and Air Force too!) trundle off the duty into the boonies year after year? Particularly when the mercury in the thermometer is attempting to break the top off the tube? The answer is disgustingly SIMPLE.

1. Failure to use the T.O. Check List. . . .

2. Did not take into account the NATOPS/Handbook performance data, runway temperature or fuel load. . .

3. Lack of complete familiarity with emergency procedures. . . .

The increase in the Navy's accident rate (non-combat to boot) in Fiscal Year 66 and resultant deleterious effect on Combat Readiness is UNACCEPTABLE. Commanders must observe closely pilots whose qualifications or attitude show evidence of complacency and take immediate positive corrective action where appropriate.


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BOB CUNNINGHAM